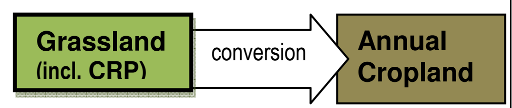
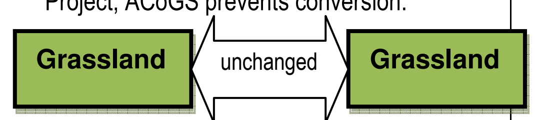
PEER REVIEW COMMENTS AND RESPONSES

A methodology for *Avoided Conversion of Grasslands and Shrublands to Crop Production* was developed by Ducks Unlimited, The Nature Conservancy, The Climate Trust, Environmental Defense Fund, and Terra Global Capital LLC, and submitted to ACR for approval through the public consultation and scientific peer review process.

The methodology was formally submitted to ACR on September 13, 2012. ACR conducted its standard internal methodology screening and the authors submitted revised drafts on October 5 and October 9. The methodology was then posted for public comment from October 17 – November 16, 2012. Public comments and responses by the authors are given in a separate document.

Following public consultation, the methodology was submitted to three peer reviewers, experts in the fields of grassland and shrubland soil science, GHGs from crop production and GHG offset methodologies, for a blind review. Peer review comments and responses are summarized below.

General Comments

	1st review	Response	2nd review	Response	Final Review	Final Response
1	The good news about this effort is that conversion avoidance might possibly be the single most effective means of enhancing terrestrial C sequestration. The bad news is that the land areas that qualify for this practice are likely to be miniscule. For the most part, arable land in North America has already been cultivated so it is too late to avoid conversion. In fact, on the North American Great Plains, natural rangeland is so rare that given the unique suite of ecological goods & services provided by such lands, arguments for conversion to annual cropland might be tenuous. Already in this opening remark I have made assumptions about the pre- (natural rangeland with perennial vegetation that has never been cultivated) and post-conversion (annual cropland) state of the land use and cover. The introductory section would benefit from a list of potential land use/cover categories that might be considered for "project" and "baseline" lands. For example, a major threat to the integrity of natural grasslands in Alberta is fragmentation and conversion from extensive grazing to small acreages or hobby farms, often with weekend or vacation residences. Presumably such a conversion would be ineligible. The document is generally pretty well written but it has numerous generalizations presented that I don't believe are appropriate.	Grassland conversion, of rangelands and restored grasslands, is a chronic issue. New farm technologies, seed varieties, crop insurance, and changing climates have made crop agriculture profitable in regions where it may not have historically, and hence conversion is widespread many portions of the Great Plains. Estimates of grassland conversion in just the United States portion of the Northern Great Plains indicate that 2M acres of grassland converted to cropland, for a net loss of 1.3 Million acres of grassland, native and non, between 2006 and 2011 (Wright and Wimberly 2013). It is true that in portions of the Great Plains where limited native rangelands remain, e.g. Iowa, Minnesota, that there would be few opportunities for avoided conversion of native rangeland projects. However, expired CRP (restored grasses under 15-20 year contracts) are eligible under the methodology and could be utilized in these and other regions. The baseline LU/LC is fully defined as production of annual crops in A.2 and A.5. No examples of project LU/LC are given in A.2 as the methodology is intended to be as flexible as possible with regards to project LU/LC, as long as they meet the criteria of A.5, which would include most grass and shrubland covers.	Clear language should be used to improve readability and to make the document easier to understand. Too slowly, one of the reviews must confess, it is becoming clear that the primary target of this protocol is to avoid conversion of the land under the Conservation Reserve Program (CRP) in the USA. Prior to implementation of the program in 1985 much of this land had been under annual crops (often marginally suited to that use). The CRP maintained this land under perennial grassland (and trees/shrubs too?), and now that the program is ending, that land is at risk of being converted back to annual cropland with considerable GHG emissions. Why not state this clearly at the outset? Recently Ruan and Robertson (2013 Global Change Biology doi:10.1111/gcb.1216) have reported on the GHG consequences of conversion of CRP land to annual cropping. CRP accounts for a vast area, and is distinct from native rangeland. Would it not be pertinent to provide a brief bit of background information on this? A simple block flow diagram might help to cut though some of the opaque, legalese-laden verbiage: Baseline, business as usual without ACoGS:  Project, ACoGS prevents conversion: 	The opaqueness is partly by design as to allow greater flexibility on the part of the project developers and potential systems. Although expired CRP is a potential project type, it is envisioned that avoided conversion of native prairies and other systems will be a primary project category. Thank you for the reference to Ruan and Robertson 2013.	Flexibility does not justify opacity; the methodology should strive to be transparent. Yes, the method is not exclusively directed towards CRP lands, but such land had been previously cultivated, and may be most susceptible to coming under cultivation again.	Footnote added to A.2 specifying that CRP and PCP are eligible project types.

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2	It seems as though this protocol has been adapted after similar protocols developed for the forested biome (assuming that the current ACoGS protocol refers to the grassland & transition biome). As a consequence, some complexity (e.g. fire/burning effects) may have been unnecessarily included. The goal is nice and clear, but the paper would benefit from a clearer definition of land use and cover types (e.g. how does shrubland differ from forest?).	Fire is a common management practice in many range systems, although it is recognized that emission impacts are possibly *de minimis* and therefore left as an optional pool for the project developer to consider. In regards to system definitions, a definition for 'Grasslands and Shrublands', 'Forest Land' and 'Trees' have been added to A.3.	While recognizing the benefits of consistency with other terrestrial GHG offset programs, ACoGS methodology must recognize the unique features of grasslands and shrublands, and their potential use (mainly for agriculture, but also for other ecological goods & services).	The authors agree and feel that these distinctions have been addressed. Unclear what additional edits or clarifications are being suggested.	Distinctions among grasslands, shrublands and forest are passable.	

A. Methodology Description

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A.1	The acronyms (section A.4) should come first, and the sources listed here should have a reference in section H, even if it is not a scientific publication a URL should be cited.	The Acronyms section has been moved to A.1, and the Sources have been moved to Section H with URLs added for these sources.	This is an improvement, which makes it easier for those of us who might be less than familiar with offset jargon. ☑	n/a	n/a	
A.2	Generally, the protocol description appears to reflect inputs from the fields of law and economics rather than natural resource management or agronomy. What constitutes a "commodity crop" is unclear until maybe p. 55. I think the crucial features to be converted (or avoided) are land cover from perennial to annual, and land use from grazing to some form of intensive harvest using machinery. Other nuances, such as conversion from natural vegetation (often with some invasive exotic plant species) to simple mixtures of introduced perennial forages (e.g. grass/alfalfa), may need to be considered. The "baseline" and "project" land conditions must be clearly defined at the outset. It seems backwards to designate conversion to annual cropland as baseline,	No changes were made in response to the first paragraph, as they appear to be general comments rather than specific correction requests. The conversion of natural vegetation to simple pastures would not be eligible under this methodology, per Applicability Conditions e and j. The authors would prefer to maintain 'baseline' and 'project' terminology for land use scenarios, as it is consistent with ACR terminology.	In general, try to avoid stacked modifiers (e.g. use annual crop production in place of annual commodity crop production; use project in place of project scenario). Agricultural commodities include: annual grains and oilseeds, dairy products, perennial and annual forages, livestock products, etc. Clearly specify which commodities, such as those derived from grazing livestock (unconfined), and possibly mechanically harvested forage (preserved forages and biofuels or not?) would be acceptable under ACoGS and which would be unacceptable (annual grains and oilseeds, row crops, etc.). Maintain 'baseline'& 'project' terminology, but	The suggestions of the reviewers are appreciated, but the authors feel it is important to maintain existing terminology to avoid potential confusion. For example, use of 'project' rather than 'project scenario' could cause confusion between the broader project, which would include both the baseline and project scenario, and more specifically the project scenario. Annual commodity crops differ from annual crop production, with the latter potentially including produce, or what is termed 'food crops' in the methodology. This distinction between	Can forage be mechanically harvested (e.g. baled hay) from the perennial vegetation on project lands and sold in the market? Hay, typically regarded as livestock feed rather than human food, is not typically traded on the futures market, is it?	Yes, hay can be mechanically harvested. A clarification has been added to applicability condition d.:" Land may remain in use for livestock grazing *and/or haying…"*

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	but eventually I got used to it. I never did get used to the term "project scenario", as I am accustomed to rival scenarios (e.g. climate projections), but not a single non-converted state. I might suggest baseline and avoided for the two LC/LU states.		use a simple diagram to illustrate it.	commodity and food crops is further defined in Section F.3.1, and therefore reference to "commodity crop" has been removed from this section. The underlying distinction between the two types of crops as defined in the methodology is that commodity crops are traded on a recognized futures exchange. For example: http://www.bloomberg.com/markets/commodities/futures/agriculture/ http://www.agweb.com/markets/futures.aspx The suggestion for a diagram is appreciated but as these are primary concepts for greenhouse gas offset protocols and projects, they would be largely unnecessary to the targeted audience.		
A.3	Full disclosure: I'm unfamiliar with the ACR and associated standards. This definitions section is crucial. Might also consider including the following terms: baseline, avoided (or "project scenario," if it must be retained), natural grassland or rangeland, shrubland, annual cropland, perennial forages, grazing, livestock, highest and best use, etc. Also, it might be useful to include a diagram to illustrate the hierarchical arrangement of the land referred to in this protocol (e.g. a project region map showing a patchwork of perennial & annual land, with some of the perennial land registered as avoided land, and the adjacent annual cropland used to inform the hypothetical baseline conditions that would have been imposed on the avoided land in the absence of the ACoGS protocol, and then further sub-division of a participant field into distinct	Definitions for several of the recommended terms have been added. Per direction from ACR, general terms defined in the *ACR Standard*, such as baseline scenario, project scenario, etc., do not need to have these definitions replicated in a methodology. A diagram of the spatial boundaries, Figure B.1, was added to Section B.1.	Often the document seems to be unnecessarily complicated. We would have hoped that the document would be self-contained so that readers would not have to refer to other documents for definitions and interpretations. Diagram of spatial boundaries is useful. Consider whether there might be a simple way to illustrate stratification (as that becomes crucial to calculate GHG offset) of project lands, without introducing excessive clutter.	The authors agree that a self-contained document would be simpler and in many ways desirable. However, the intended reader of the methodology is a potential project developer, and this group will be familiar with the format and reliance on ACR program documents and definitions. Feel that stratification example is not necessary and will depend on project types. It is generally not typical for GHG methodologies to contain numerous diagrams or illustrations.	On the basis of this methodology document alone, it is difficult for the reviewers to understand and evaluate all the requirements ACOGS projects would have to meet. Review of the ACR Standard was outside the scope of this review effort. Since the ACR Standard is an ACR policy document,	

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	LC/soil strata)l.				the reviewers rely on ACR to ensure that all the ACOGS-specific requirements in this methodology are compatible with the ACR Standard.	
A.4	Given the use of acronyms in the definitions, consider switching order of A.3 and A.4.	Per Comment A.1, the Acronyms sub-section has been moved to the beginning of Section A.	☑	n/a	n/a	
A.5	a. implies that forage land that may have been intensively used for annual cropping, 10 or more years previous are eligible, thus ACoGS could inhibit routine pasture renovation	Yes, a.) implies that land that was intensively cropped in the previous 10 years would be ineligible, as the project type would more accurately be one of grassland restoration. However, land that was in annual cropping more than 10 years ago, e.g. CRP, would be eligible. Yes, pasture renovation with intensive tillage would not be permissible as it would disturb SOC. If these points need to be more explicit, please advise to do so.	Explicitly specify that most lands maintained under the CRP would be eligible (this makes it clear that project lands are not necessarily confined to native rangeland, since most CRP land had been cultivated 10 or more years ago)	Although minor, the authors would prefer not to add this specification. CRP would be irrelevant to project developers in Canada, and it is not necessarily the case that most CRP lands would be eligible as there are many non-grass acres in CRP.	Do not understand the aversion to acknowledge the existence of land influenced by the CRP (USA) or the Permanent Cover Program (Canada).	Footnote added to A.2 specifying that CRP and PCP are eligible project types.
A.5	b. perhaps a Land Conservation Agreement is similar to an Environmental Farm Plan in Canada?	The Land Conservation Agreement is defined in A.3 Definitions.	☑	n/a	n/a	
A.5	c. this condition could become a major stumbling block for project enrollment, because it is difficult to obtain objective appraisals, let alone determinations of 'highest & best use'. This assumes that farmland value is closely related to productive value, when in fact it is determined by market forces that have heavy components of speculation, and anticipation of future changes in resource development (e.g. improved highway access, wind farms, fossil fuel extraction, etc.) Under 'c', **what is the basis for using 40% greater appraised value?** This needs to be clarified. Does it include price supports / gov't payments? It should not	c.) The Uniform Standards of Professional Appraisal Practice USPAP codes (http://www.uspap.org/) provide an objective set of criteria which appraisals need to be performed against and are recognized by the Internal Revenue Service for property valuations. For an example of use by IRS, see page 4 of the following link: http://www.irs.gov/pub/irs-drop/n-06-96.pdf. It is recognized that farmland values may reflect numerous market dynamics. In situations where market forces are primarily	Would the opinion of a land economist be useful here? An appraiser will estimate the market value of the land according to prescribed standards, but this value may have little to do with the value of potential agricultural production and much to do with expected increases in land value associated with future scarcity ("they aren't making any more land…"). In fact, much of North American farm wealth is attributable to appreciation of farmland, rather than to its productive value. Often the primary market force is speculation determined by the return on a dollar	Great points. It is recognized that non-agricultural factors can be a determinant of localized land values. See the discussion of Plantinga, Lubowski and Stavins (2002) in response to comment F.1.3, for how these effects are regionally distributed. As Nickerson et al note, non-farm income streams would also push up pasture/grassland values and therefore diminish any cropland premium to convert grassland. From p.	☑ It seems reasonable to expect speculative pressure to be roughly equal for perennial grassland/shrubland and for annual cropland, right?	

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	include any type of government payments or subsidies in the cropping program.	development, and not agriculture driven, the Agent of Conversion would not be converting to annual cropland, and the project would not be eligible under this methodology. The 40% threshold in appraised values is a minimum difference. It is not anticipated that projects will be economically viable that are appraised at less than a 100% differential, as the Discount for Uncertainty of Conversion (ACD) will reduce the number of eligible ERTs substantially. The basis of 40% as a minimum threshold is based in part on the California Air Resources Board Compliance Offset Protocol – US Forests, which uses a 40% threshold for Avoided Forest Conversion. Based on observations of grassland conversion in the Dakotas from 2007 to the present, a 40% differential in land values is sufficient to drive grassland conversion. Regional cropland values, as they inform the appraisal, will reflect subsidies and expected future returns from crop activities. Unfortunately, economic studies of grassland conversion to date include one or several limitations that make their application to estimation of parcel-specific conversion probabilities limited, e.g relying on data that is several years old, based on regional averages and not parcel specific, or accounts for rental rates and not land value. As recently documented by Wimberly and Wright (2013), grassland conversion rates from 2006 to 2011 in the Western Corn Belt have not been as high since the Dust Bowl. During this time period, real land values (ERS farmland real estate values, GDP deflated to constant $2005)	invested in farmland vs. the stock market. Further details on this may be found in Nickerson, et al. 2012. Trends in U.S. Farmland Values and Ownership. EIB-92. USDA Econ. Res. Serv. 48 p. They observed that "A lack of correlation with net farm incomes, declining rent-to-value ratios, and low levels of affordability all suggest that nonagricultural factors are increasingly important in determining farmland values." Furthermore, even if market value is largely determined by potential agricultural production the prospects of a program like ACoGS likely would influence the market (e.g. supply of unencumbered annual cropland would be diminished). The threshold by which cropland value must exceed grassland value for conversion to occur ultimately is an arbitrary and subjective guess about the interplay among productive value, market value, and the probability that conversion will occur. The proposed 40% threshold seems reasonable, but the rationale for selecting that value should be clearly presented in the document. Our concerns are adequately addressed, but the justification should acknowledge subjectivity, and include some supporting references. The paper by Rashford and coworkers (2010 Conserv. Biol. 25(2):276-284) predicts how the probability of conversion increases as the returns to corn increase, at least on the better land, whereas the probability for unsuitable land remains low regardless of returns to corn. While this paper lacks a specific land value for conversion, it does use corn returns ($/ha) to predict probability of conversion, and should be included in the list of references. Similarly, the paper by Secchi et al. (2011	4: "However, cropland value premiums have declined over the past 10 years in every region except the Northeast…. Nonfarm income streams that accrue to pastureland would contribute to declining cropland premiums." As long as the speculative factors have an equal effect on both agricultural uses, the relative difference in values among agricultural uses will still be a useful indicator for grassland conversion to cropland. The reviewers are correct in observing that ACoGs programs could have an effect on long-term cropland land prices, thereby incentivizing further grassland conversion. These indirect land-use effects are captured through the market leakage assessment and deduction. The authors agree that the 40% threshold value is ultimately a subjective policy decision, although informed by the sources identified in the initial response. Reference to the Rashford et al, Secchi et al, and other papers (Claussen et al, etc) have been added as a basis for returns-based risk assessment of conversion in Section D.1 as a footnote, copied below. The authors feel this is the more appropriate location in the methodology to explain the reasoning behind the 40% determination rather than in the Applicability Conditions. Footnote: The selection of a minimum		

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		increased over 50% in North and South Dakota.	Biomass & Bioenergy 35:2391-2400) projects how the area of CRP land converted to annual cropland (as well as amounts of sediments, N, etc. lost from this land)) increases with corn price.	40% land value differential is ultimately a policy decision that was informed by a similar criteria employed by the California Air Resources Board Forestry Protocol for Avoided Conversion, and studies of land use change that observed correlations between increasing cropland returns and grassland conversion (Claassen et al. 2011, Secchi et al. 2011, Rashford et al. 2012, Wright and Wimberly 2013).		
A.5	Also under 'c', check reference to 'as defined in 0'. The equation number is missing.	Reference has been added.	☑	n/a	n/a	
A.5	d. change "animal husbandry" to "livestock grazing", as the land won't be used for confined feeding	Edit has been performed as suggested.	☑	n/a	n/a	
A.5	e. clarify complete conversion: if you renovated a 10 yr. old stand of alfalfa by plowing & re-seeding, would that land be eligible?	Further clarification added for conversion.	☑	n/a	n/a	
A.5	h. Please specify role of agroforestry (if any) under 'h'.	Clarification added that perennial crops are not eligible, as well as flood irrigation, which relates to the tools used to quantify N2O emissions.	Please expand on this condition. Is the intent to allow grazing, but prohibit mechanical harvesting and removal of plant materials for off-site feeding to livestock or manufacturing of biofuels/bioproducts?. Why would there be a restriction on irrigation? Even if this is warranted, why would flood irrigation be prohibited, whereas sprinkler irrigation or perhaps sub-irrigation would be permitted?	The CDM tool which the N2O emissions equations are based upon specifically excludes flood irrigation as an applicability condition. See p.1: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-07-v1.pdf Perennial crops are excluded because of accounting convention for Above Ground Biomass.	So flood irrigation is presumed to accentuate soil N_2O emissions, and presumably any form of irrigation may elevate productivity potential to the extent that it becomes too expensive to pay for avoided conversion? How can perennial crops be excluded	Correct, flood irrigation is expected accentuate soil N_2O emissions. Where any form of irrigation is technically and financially feasible, avoided conversion will be prohibitively expensive.

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					(bad economics & bad ecology)?	It is recognized that conversion to perennial crops does occur in some locations and may lead to a net increase in GHG emissions. However, the predominant form of current grassland conversion is to row crops, which is the focus of the methodology. As the science and economics of a perennial crop baseline are uncertain, the authors did not feel the extra considerations were worth pursuing at this time.

B. Project Boundaries

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B.1	Spatial boundary seems well described, but an	A diagram of the spatial boundaries,	☑	n/a	n/a	

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	illustration showing the boundaries and strata could be useful	Figure B.1, was added to Section B.1.				
B.1.1	Typically, rangeland is characterized by complex terrain, and the primary reason it has remained and will continue to remain rangeland is that the slopes are too steep, there are too many stones, there are steep drainage channels dissecting the landscape, etc. for effective use as annual cropland. Such rangeland is excluded from the ACoGS protocol, as it is ineligible for conversion. If the number of strata per 65 Ha parcel exceeds about four, I would question the wisdom of ever converting the land to annual cropland.	It is not anticipated that stratification will occur at the Participant Field level, although an option, but rather the Project Region. The appraisal, by comparing regional land uses on lands with similar geographical attributes, will screen whether the geography of the Participant Field is unsuitable for crop production.	Is there a need to identify the smallest area that will be considered to constitute a participant field? For a typical 64 Ha field, a perimeter of grassland about 3 m wide occupies 1 Ha. Similarly, how large may a non-cropland area (e.g. steep ravine that must be left under perennial cover) be before it must be quantified and excluded from the participant field?	The authors considered including minimum and maximum units but decided against such restrictions as they would likely vary by geography.	☑	
B.1.1	To what degree are differences in topography and drainage characteristics attributed in the stratification approach? Accounting for spatial differences in previous management (i.e., management history) should also be considered.	See above.	This is adequately covered in the second paragraph on page 13.	If adequately covered, should the comment be checked off?	☑	
B.1.1	Pg 11. Soil texture would be a better term than soil type considering the breadth of the audience this is intended to reach.	'Soil type' was replaced with 'soil texture', as suggested.	☑	n/a	n/a	
B.1.1	Footnote 2 (p. 10) is disconcerting. Stratification usually increases sampling intensity. If participants are allowed to sample without stratifying the project area, what type of sampling scheme should they follow to adequately capture site characteristics? As currently written, the footnote implies one can 'cut corners' on site characterization.	The footnote has been removed and significant additional guidance on the Stratification has been added to section B.1.1 of the methodology to clarify.	The correlation between slope position and texture is not broadly applicable, especially on lacustrine, loessial or aeolian parent materials. Broad soil textural classes should be available from soil surveys or other resource inventories, so detailed information on particle size analysis is superfluous.	References to slope position have been deleted, as have discussions of soil particle size. An encouragement to utilize soil textural classes from inventories has been added.	☑	
B.1.1.1	Change to ***Baseline Cropland Management***	Change made.	☑	n/a	n/a	
B.1.1.1	Typical cropping sequence, including the use of summer fallow and could replace typical crops and rotation length. Harvest intensity should also be stated explicitly, so it is clear whether only grain is removed or both grain and residues (e.g. for	'Typical cropping sequence' has replaced rotation and crops. Where biogeochemical models are utilized, harvest intensity and rate of residue removal will be necessary	It seems unbalanced to have subsection B.1.1.1 describing baseline cropland management, but no subsection B.1.1.2 describing management of 'project grassland'. Would such management be	Many of the project management requirements are captured in section F.2.6 Livestock Emissions. Synthetic and other organic N fertilizer is currently captured in	☑	

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	livestock bedding or other bio-products) are harvested. Other management factors should be considered (e.g., cropping intensity, soil amendments, biomass removal, **irrigation**, etc.). Additional baseline data might include frequency of fallow, type and rate of organic amendments, use of burning, and inclusion of cover crops.	inputs and therefore required, per the last bullet. The additional management factors identified are addressed through the bullets pertaining to other inputs or nutrients, irrigation, and other necessary model inputs. A bullet has been added to cover burning, cover crops, and fallow.	confined to grazing (herding, fencing, placement of water supplies & mineral supplements), and periodic burning or maybe even herbicides? Would synthetic N fertilizers and irrigation (of any form) be prohibited? The paper by Chamberlain et al. (2011 Agric. Ecosyst. & Environ. 141:332-341) provides some insight as to the input requirements required for using DAYCENT to simulate conversion of cotton cropland and unmanaged CRP lands to managed switchgrass.	F.2.5. Irrigation for the project scenario has been prohibited through additional language to applicability condition h. It is not envisioned that irrigated pastures would participate as the investment/costs of irrigation would demand higher returns and higher valued crops. Thank you for the reference to the Chamberlain et al 2011 paper. A reference to the paper has been added to Section F.1.1		
B.2	Other temporal aspect from A.5, a. is LC/LU in 10 years preceding start date	An additional line has been added to address this point.	Is it correct that all stratification is spatial (section B.1.1), and there is no temporal stratification? Otherwise that should be explained and carefully distinguished in this section.	Correct, all stratification is spatial.	☑	
B.2.1	Seems strange to pay retroactively for avoided conversion. If it has not been converted, there must have been other factors such that the ACoGS was immaterial. Why 11/1/1997?	The start date of 11/1/1997 is an ACR specification. Previous avoided conversion would only be eligible if the Project Participant-Land Owner had explicitly conveyed GHG rights at time of entering into a Land Conservation Agreement, thereby indicating the role of carbon finance in their land use and management decisions.	☑	n/a	n/a	
B.2.1	Should 'biological carbon pools' be 'terrestrial carbon pools'?	Agreed, 'biological' has been replaced with 'terrestrial' in B.2.1.	☑	n/a	n/a	
B.2.1	Baseline management scenario re-evaluation should consider all aspects of agricultural management, not just crop rotation.	Agreed, edits made to address.	☑	n/a	n/a	
B.2.2	On the other hand, pressures to convert will only intensify in the future (unless we have a global	The 20 year Crediting Period is essential for administration. The ACR	☑	n/a	n/a	

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	plague or asteroid impact or …). The 20 year time limit likely is essential for administration, but at year 15 some serious thought must be given to extending the program, otherwise the land will be almost certain to be converted. Clarify that 20 yr project + 4 x 20 yr renewals = 100 yrs	required 40-year agreement and permanence buffer provides a strong incentive for the Project Area to remain in the project LU/LC, even if the crediting period has expired. Correct, it is a 20 year initial crediting period plus the potential four additional 20 year terms for a 100 year total duration.				

C. Carbon Pools and Greenhouse Gas Boundaries

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intro	Intent of opening paragraph is unclear. GHG emissions on avoided land will be smaller than those from arable cropland. The challenge is to estimate GHG for suitable baseline cropland. For the participant field, simply apply the steady-state assumption to the terrestrial C pools and count livestock to estimate CH_4 eructation and a small amount of N_2O from excreted N.	The first paragraph provides the basis for which pools and sources are to be accounted for. The comment is correct as to the relative emission between the project and baseline systems. The distinctions among pools, sources and gases are explained in Sections C.1. and C.2 .	The verbiage seems opaque. Could *de minimis* be changed to negligible? Could *ex ante* be changed to before? 'Leakage emissions' is another confusing term, as leakage typically refers to a fluid (liquid or gas). In GHG offset jargon, leakage could refer to unintended conversion of non-project grassland associated with an offset program like ACoGS. Post et al (2012 Frontiers in Ecol. Vol. 10 p. 559) include a transparent explanation of GHG leakage. Good to see reference to the various CDM A/R tools, but these should specify the present version number (1), rather than whatever is current (changes cannot be anticipated).	There is a strong preference to maintain *de minimis*, *ex ante* and leakage as is, as they are commonly used terms among the GHG offset community. Leakage is a core concept in land-based GHG offsets that additional references should not be needed. The *ACR Standard* also provides a detailed explanation of leakage for the uninitiated. The references to CDM A/R tools have been updated to include present version numbers where a specific equation is referenced. Where guidance refers to the "latest version", this nomenclature is retained as it allows the methodology to remain accurate as versions are updated. Citations in the reference section include the latest version number.	☑	
intro	What is the basis (p. 15) for using <3% as a basis for not accounting for SOC/GHG dynamics? Can we actually measure and calculate this small of a change with much certainty?	The 3% rule comes from the ACR Standard. The intent is that, even though established practice in GHG accounting allows insignificant or *de minimis* impacts to be ignored, ACR does not want to allow these impacts in	Does the 3% rule come from a CDM A/R tool or from an ACR tool or both? Please be specific, cite the relevant document(s) that are listed in the references, and make it clear that this is a standard criterion for all ACR methods.	The source is the *ACR Standard*, not a CDM tool.	☑	

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		the aggregate to exceed 3% of the project's total estimated GHG reductions. The wording is: The Project Proponent must present evidence that exclusion of the GHG source, sink or pool is conservative, i.e. exclusion will underestimate rather than overestimate Net Emission Reductions. If exclusion of a source, sink or pool is not conservative, the source, sink or pool may be excluded only if all combined sources, sinks and pools thus excluded represent less than 3% of the ex ante calculation of emission reductions/removal enhancements.	The cited wording, from an unknown source, provides a clear explanation without using *de minimis* or *ex ante*.			
C.1	The role of trees and shrubs should be considered explicitly. Presumably deforestation/afforestation is covered in other ACR protocols or other instruments altogether. Is there some demarcation to distinguish shrubland and forest? How is tree encroachment on rangeland handled? In some rangelands trees are an important components (e.g. ponderosa pine-blue bunch wheatgrass community), whereas in others they may be degrading invaders (e.g. aspen into fescue grassland).	Definitions for 'Grassland and Shrubland,' 'Forest Land', and 'Trees' have been added to Section A.3 to provide a more explicit distinction between and shrub and forest systems. The definitions are based on the US EPA GHG Inventory and the ACR Forest Carbon Project Standard, and are consistent with IPCC AFOLU GPG. Encroachment is addressed by Applicability Conditions 'd', 'e' and 'j'.	Good clarification of definitions in section A3, p. 7; also great to see the references to the report included footnotes (or as references in section H?); this makes for a more transparent document. Applicability conditions do help to address encroachment. Is there some place that excludes the application of synthetic fertilizer and organic amendments (apart that excreted by grazing or unconfined livestock) on participant fields? Second sentence under C1, likely should be "The project proponent may elect to…"	There is no applicability condition that excludes the application of synthetic fertilizer or organic amendments in either the project or baseline. The second sentence of C1 has been edited to "Project Proponent".	Symptomatic of persistent confusion is what is meant by organic amendments. Would applicability condition i on p. 10 not exclude manure (apart from that deposited by grazing livestock), a major organic amendment on most farms? If used at all on perennial grasslands and shrublands, synthetic fertilizers must be used judiciously and managed carefully to prevent any benefits from C sequestration from being more than offset by	A clarification has been added to applicability condition i: *There are no restrictions on the application of synthetic or organic amendments, i.e. manure, in the baseline scenario.* Application of synthetic fertilizer is an eligible practice for the perennial vegetation of the project scenario and accounting mechanisms are in

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					elevated N_2O emissions.	place to account for the associated N_2O emissions. The authors agree that over application could lead to elevated emissions and this will need to be taken into consideration by the Project Proponent when assessing potential projects.
C.1	Distinguishing below-ground biomass from SOC is difficult; it is misleading to portray these as discrete pools.	The separation of SOC and below-ground biomass is common practice for GHG accounting, e.g. ACR REDD methodology, IPCC GPG LULUCF.	This theorizes the immeasurable. In grasslands the distinction between below-ground plant biomass (or C) and soil organic matter (or C) is hopelessly blurred, and over-confident assumptions about such distinction contributes to much addlepated thinking. This distinction is difficult in forests (see research on fine root biomass) and unrealistic in grasslands.	The relevant question is not whether the pools can be distinguished, but whether they are being double counted. Because root:shoot estimates are empirically based using only material that is unambiguously root biomass, they represent a conservative estimate of root biomass and can be used without significant risk of double-counting carbon.	SOC measurements typically include root C, so double counting is practically inevitable. Better to adopt a method that strives for representative sampling across both pools.	In our experience, and in the literature we are familiar with, SOC measurements typically are based on soil with visible plant material removed. We have clarified in the methodology that SOC should be quantified with a sampling method that excludes visible root biomass, or based on a model that is calibrated with samples that have excluded visible root biomass.
C.2	Often rangeland soils serve as a small CH_4 sink, but soil N_2O emissions can be equally small	Fire emissions were initially included for the sake of conservativeness, but have	☑	n/a	n/a	

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	so emissions are offset. If CH_4 uptake is considered negligible, then the effects of fire on CH_4 emissions must be similarly negligible. Perhaps the fire-associated emissions of CH_4 & N_2O are a carryover from protocols in forested systems, and the evidence base for this source in grasslands and shrublands is scant?	been removed.				
C.2	Direct soil N_2O emissions are from synthetic fertilizer N, plant N recycling (residue deposition and decay), organic amendments, and waste excreted by grazing livestock (mainly urea in urine).	Correct, these sources and estimation approaches are described in Sections D and E.	Should be "Covers emissions from synthetic fertilizers and organic amendments, but accounting for indirect N_2O emissions is optional." Eliminate the reference to N_2O from N-fixing plants, as this is captured in estimates of N_2O from plant N/SOC recycling, whether N-fixing or not.	Reference to N-fixing plants removed.	☑	
C.2	A minor point, but should CO_2 degassing be considered for irrigated carbonate soils? This can be an issue in arid regions (see Emmerich, 2003).	Flood irrigated soils are excluded from the project, per edit to Applicability Condition h. It is still possible that soil CO2 emissions from inorganic carbon pool could occur, but as these would increase the emissions of the baseline scenario, it is considered conservative to exclude.	The consequence of irrigation is unclear. Does this refer to irrigation of project grasslands or does it refer to baseline cropland? Why is flood irrigation distinguished from sprinkler or some other form of irrigation?	Flood irrigation is specifically excluded in the CDM A/R tool (see comment and link to A.5). Additional language added to applicability condition h that all forms of irrigation prohibited for the project scenario.	☑ Flood irrigation is out, and all forms of irrigation are out for project grasslands where conversion to annual cropping is avoided. Presumably, any changes in soil inorganic C are out as well (maybe appreciable in some scenarios?).	Correct, soil inorganic C is excluded. By excluding consideration of any decreases in mineral C following conversion makes the methodology conservative. We are not aware of any scenario that would result in the increase in mineral carbon following conversion.

D. Procedure for Determining the Baseline Scenario

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intro	Specifying the baseline land use, land cover and management is problematic, because it is hypothetical. The goal of transparency in this is admirable.	The intent of specifying the four alternative baseline land uses is that each must be considered and assessed. Only additional and	Try this opening: "This section identifies the baseline cropland and corresponding management practices that the ACoGS Program intends to	Prefer to maintain current opening sentence, as a baseline of cropland and particular management practices is not presumed. We do not feel it is necessary to specify	The reviewers continue to find this section confusing since the rest of the methodology seems to	

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	Four alternatives are proposed, but it is unclear which of these might be eligible for the ACoGS protocol. I might guess only the 3rd one (conversion to annual cropland), but cannot be sure.	therefore eligible ACoGS projects will fall under the third category, conversion to annual cropland. The convention of initially considering all conceivable alternative land use scenarios, then identifying as the baseline the scenario that is most attractive or faces the lowest barriers, was established in various UNFCCC Clean Development Mechanism baseline/additionality tools and is fairly common in GHG methodologies.	avoid. Before a field may be enrolled in the program, however, it must also satisfy the conditions for additionality outlined in section E." Switch the order of the last two of the four land use scenarios, and add something to the effect that "Only the last of the four above land use scenarios would be eligible for inclusion in an ACoGS project".	what land use is "additional", as this is addressed in Section E. The intent of this section is to lay out land uses to be considered in this determination.	assume a baseline of conversion to annual cropland. However we are willing to accept the methodology convention of requiring Project Proponents initially to consider all possible land use scenarios that could occur on the project lands in the absence of the ACOGS project activity.	
intro	I wonder if some legalese might be eliminated to improve clarity. The last sentence of the intro (p. 19) is particularly opaque. If *ex ante* must be used, should it be italicized and have no hyphen.	Throughout the document *ex ante* has been italicized and the hyphen removed. The authors attempted to limit legalese wherever possible, but feel that the technical nature of this section necessitates legal and other terms defined within the methodology to accurately convey the pertinent concepts.	In general, the document seems to focus on minutiae while neglecting important issues, like the implications for biofuels/bioproducts from the cropped baseline or from the project grassland. Pineiro et al. (2009 Ecol. Applications 19:277-282), among others, have discussed the implications of grassland conversion to produce biofuels. Future advances in cellulosic biofuels or in direct combustion technologies may create other viable uses for the products of perennial grasslands.	By excluding perennial crops, the methodology directly excludes a baseline of perennial biofuel crops. Conversion of grasslands to corn for ethanol production is a concern and would be addressed by the methodology as currently written. As the conversion threat has yet to develop for perennial/cellulosic biofuels, and the associated management practices yet unidentified, the implication for the project scenario are not addressed. It would be expected that these activities would occur similar to haying events, and associated emissions otherwise covered under the project quantification categories.	Baffling: if conversion of perennial grassland to annual cropland is successfully avoided, then the land must produce a perennial crop. Does the method imply that the only acceptable use of this perennial crop is grazing/browsing by livestock (no hay harvest)?	Clarification added to applicability condition i to explicitly recognize haying as an eligible activity in the project scenario.
D.1	Again, some of the legalese hampers my comprehension. Of course here "agent" refers to an anthropogenic agent, such as a person, organization or company, whereas I'm inclined to regard various soil and environmental processes (e.g. erosion, grazing, invasion, drought) as agents of change. The importance of distinguishing between identified and unidentified agents of	Correct, the agent is an anthropogenic agent. The distinction between the identified and unidentified agent is central to the necessary proof of burden for baseline and additionality determination, and quantification, Section F.1.3	Change title of section D.1 to "Person, Company, or Agency Intending to Convert Grassland to Cropland" Distinction between IA and UA is important to estimate the discount for uncertainties about conversion (i.e. more uncertainty with UA), but is it also used for the 'leakage' estimates in section F.3?	Agent nomenclature is strongly preferred, as it is also used by the ACR Forest Carbon Project Standard. Correct, IA and UA distinction is also relevant to the leakage analysis.	☑	

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	anthropogenic change is unclear to me.					
D.1.1	It seems reasonable to exclude rangelands that are unlikely to be converted because they are already protected within a park or by a conservation easement. Sometimes the presence of a formally listed species at risk (plant or animal) may be sufficient to prevent changes in LU/LC that might degrade habitat for a certain animal or eliminate a plant (e.g. *Cryptantha minima* in Alberta) Perhaps it should be acknowledged that the ACoGS protocol likely will be unable to prevent right-of-way access, such as that associated with power lines (often associated with wind energy projects), pipelines and roads. It may be an arduous requirement to procure documentation to the effect: "enroll this land in the ACoGS, or the rangeland will be plowed and there will be no place for the deer and the antelope to play". I'm unaware of any formal procedure for a "new breaking request" in Canada. Some jurisdictions may have well-defined requirements and associated documentation for only a small subset of possible LU/LC changes (e.g. licensing land for irrigation). Clarify whether an appraisal is narrowly confined to financial/real estate considerations, or broadly encompasses financial and ecological aspects (e.g. requiring a botanical survey or assessment). Perhaps dated air photos might help to document the propensity for converting perennial rangeland to annual cropland in the project region. Another crucial document might be a title deed: if the title owner is tempted to convert, enrollment in ACoGS may	The methodology authors agree. The appraisal process will take regulations into consideration, such as the Endangered Species Act in the United States, which would affect the possible LU/LC. It is true that the ACoGS protocol will not be able to prohibit conversion due to right-of-way or mineral developments. Monitoring will identify if such an event occurs, and the ACR Standard's reversal and permanence buffer requirements would become applicable. However, the land surface impact of these activities tends to be relatively small. The appraisal is strictly a real estate appraisal, as defined in D.1.1 and D.1.2.1, but could indirectly consider ecological aspects, e.g. wetland density, weed infestation, etc. There is a general paucity of accurate regional data on grassland conversion, and for what is collected, there is a general time lag as to when it becomes available. Although regional aerial photos would be useful in identifying areas of rampant conversion, such an exercise would be cost-prohibitive for most project developers. Further, a 5 to 10 year set of data would not be readily available. The appraisal and land value differential, as well as the documentation of similar conversions in the Project Region are meant to	Using strictly a real estate appraisal seems to neglect the potential flow of ecological goods and services from avoided conversion of grasslands and shrublands. Likely the intent of this is to err on the side of least intervention in the farmland market and farmland use. Despite much debate over the years it appears that we still have not yet reached a place where values can be ascribed to things like biodiversity, soil conservation, water quality, hydrologic buffering, etc., that are not priced in the market. In a recent review (2012 Frontiers in Ecol. 10:554-561) Post and co-workers emphasize that GHG management has considerable benefits to ecological goods and services that extend beyond terrestrial C sequestration alone. If aerial photography is too expensive to assess land use changes in a timely manner, perhaps some other remote sensing technique may be applicable. For example, see the paper by Maxwell and Sylvester (2012 Remote Sensing of the Environment 121:186-195) in which they use Landsat data to agricultural land under contrasting uses. Similarly, Egbert and coworkers (2002 Computers & Electronics in Agric. 37:141-156) observed that Landsat imagery was cost effective and sufficiently accurate assessing grassland conversion.	It is true that a real estate appraisal would not directly capture many of the non-market Ecological Goods and Services of grasslands. If they were, it is likely that less grassland conversion would occur. However, it does reflect the current economic paradigm which is driving the conversion threat. Landsat was considered by the authors as a potential land use change estimation tool, as were other remote sensing technologies. Unfortunately for grasslands, misclassification errors tend to exceed conversion rates, making their use limited without additional ground truthing. The Maxwell and Sylvester 2012 paper does not contain any ground truthing, but rather a comparison to other Landsat or Land Surveys. Even with these comparisons, grasslands or "never cropped" were misclassified at an error rate of 10-30%. Annual conversion rates of 1-5% can easily be lost in the noise of Landsat without extensive ground truthing. Although a novel advancement, the approach outlined by the authors does not appear ready for wide scale implementation.	☑	

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	provide a valid GHG offset. In contrast, ownership of "Public" or "Crown" or "Lease" land is held by some level of Government, which likely has assorted policies that could hamper or prevent conversion.	capture and reflect these conversion pressures.				
D.1.2.1	Unclear how this demonstration of financial viability differs from the appraisal required in para 3, p. 20 when the agent is identified. I question the identified/unidentified dichotomy – couldn't it be simplified by making the more rigorous set of requirements applicable to all rangelands threatened with conversion? Pg 21. Again, the question of validity of the 40% higher value issue.	Financial viability is a required component of the Additionality determination, per the ACR Standard, for which the appraisal is used to satisfy. The identified/unidentified dichotomy addresses an important stage in the decision making process of landowners. The greatest threat of conversion is believed to occur when the initial producer retires and looks to transfer the land to a relative, or lease/sell the land to a different agent. The second producer, or unidentified agent, is the agent that will implement the conversion, as their management preferences differ from those of the initial producer. It is unlikely that the conversion agent would entertain an offer to avoid conversion once they've obtained decision making authority, and therefore why it is important to include the unidentified agent. See previous response to comment A.5 at the top of page 4.	If the requirement for financial viability applies to both identified and unidentified agents, this section should be moved to D.1 or earlier on p. 23. The threat of conversion, assuming the land is even marginally suitable for arable annual cropping, will intensify as the differential in productive value (use as perennial grassland vs. annual cropland) increases. This is supported by previously cited papers (Secchi et al. 2011 and Rashford et al. 2010). Regardless of land ownership, the incentive to convert increases with the income differential, although the opportunity cost of not converting may be smaller for a farmer nearing retirement compared to a new farm operator eager to maximize returns. In regions with substantial livestock populations, the extent to which forage from perennial grasslands may substitute that from annual cropland (e.g. corn silage) could possibly influence financial viability (high corn prices may increase the value of grazing land).	Agreed, the previous D.1.2.1 section has been moved to D.1, and references throughout the methodology corrected. We agree with the statements regarding the differential in land value driving conversion, as influenced by the referenced papers. In regards to the opportunity cost of conversion relative to producer characteristics, there is little doubt that these factors can influence a producer's decision making process. Although older producers may have a lower incentive to maximize long term income, they likely have a stronger preference for short term income and liquidity. By restricting the use of their land to a less profitable use, they would realize this decrease in income in a land sale, thereby decreasing short term income, assuming older landowners more likely to sell or transfer land than younger landowners. The interaction of livestock and corn markets are undoubtedly complicated. As most livestock are finished on corn, high corn prices could depress livestock prices and lower demand for pasture.	☑	
D.1.2.2	The history of LU/LC conversion in the region of interest seems relevant to both types of agents. Air photos may help document this, but I suggest information spanning even 10 yrs (instead of the proposed 5 yrs) would be	Where available, air photos can be used to document conversion in the Project Region. Since the methodology is only applicable to the avoided conversion to annual crop production,	Understood; as noted previously by authors, the areas associated with such land uses likely would be small (and not applicable in any case). As noted previously by reviewers, remote sensing	Agreed, Landsat imagery could be a useful tool for documenting land use history. See comment above, D.1.1.	☑	

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	relevant. The planning horizon for major infrastructure (e.g. highways, electricity transmission lines, pipelines, recreational development) often exceed 10 yrs, and can have an appreciable influence on adjacent LU/LC (related to access, encumbrance, etc.).	other conversions would not be applicable.	including Landsat imagery may prove to be a cost-effective tool for assessing land use history.			
D.2	Perhaps baseline management only needs to be re-assessed once every 10 years, unless there are major changes (e.g. a shift from annual crops to perennial forages, or to root/tuber crops)	Baselines are assessed every 5 years. If a major shift in practices occurred between 5 year intervals, then the crediting baseline would reflect such a change *ex post*.	If changes to the baseline cropping scenario are permitted after the fact, then reassessment at 10 yr intervals might be even more attractive.	For project developers, a 10 year reassessment interval would likely be appealing relative to a 5 year interval. However, a 5 year reassessment would provide a more responsive assessment representative to current practices and was implemented per the suggestion of ACR. We also think the 5 year re-assessment requirement best captures potential changes to baseline drivers, given that Farm Bills are written every 5 years and other market/policy shifts/cycles appear to happen more frequently than 10 years.	☑ The reviewers agree and suggest that this methodology should be regularly revisited and updated on a 3 to 5 yr schedule to incorporate new science pertinent to GHG emissions and offset projects.	

E. Procedure for Determining Additionality

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E.1	Provide a definition of additionality, and a brief explanation of why it is important (I'm guessing to ensure ACoGS achieves real reductions in GHG emissions that would not have occurred otherwise). I'm not certain what "regulatory surplus" refers to, but the basic concept seems to repeat those in section D that specify the rangeland must not already be protected from conversion by other means (e.g. park, bird sanctuary, military	Additionality and Regulatory Surplus are both defined in the ACR Standard v2.1,[1] and therefore a definition within the methodology is not necessary. The reviewer's understanding of the basic concept of regulatory surplus is correct.	Include this citation in section H: American Carbon Registry (ACR). 2010. ACR Standard version 2.1. ACR c/o Winrock International, Arlington VA 57 p. Available at: americancarbonregistry.org/carbon-accounting/carbon-accounting/american-carbon-registry-standard-v2.0	Reference added.	☑	

[1] See http://americancarbonregistry.org/carbon-accounting/carbon-accounting/american-carbon-registry-standard-v2.0.

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	reserve, conservation easement).					
E.2	I think I see the intent, but the wording is clumsy. Three words seem to be used where two might suffice (e.g. APC or avoided planned conversion instead of avoided conversion). In this section, use of the terms participant, agent, entity and proponent are confusing; simplify where possible and clarify where distinctions must be made.	References to APC and Avoided Planned Conversion have been replaced with AC and Avoided Conversion. Project Participant, Agent, and Project Proponent are defined in the definitions section, A.3. Since each term represents a different entity, the authors feel it is important to maintain these specifications.	☑	n/a	n/a	
E.2	Do multiple project activities mean some parcel of rangeland may be enrolled into both the ACoGS protocol, and an enhanced rangeland management protocol (if such a thing exists) to create ERTs both by avoiding conversion, and by enhancing range management?	No, the intent here is not to refer to the possibility of implementing multiple different activities (under different methodologies) on the same parcel of land. Instead multiple project activities refer to multiple parcels, i.e. the activity, aggregated under a single project (under this ACoGS methodology) for the purposes of registration on ACR and verification.	Please clarify whether you are referring to multiple activities or to multiple parcels of land.	Multiple parcels of land. A clarification has been added to the second sentence of Section E.2.	"multiple project activities, i.e. Participant Fields"	Correct.
E.2	It is unclear whether "common practice" refers to LU/LC conversion, or to the use of 99 year easements.	Common Practice refers to the use of easements, or Land Conservation Agreements. Text was added to the last sentence of the first paragraph to make this more explicit.	The third bullet on p. 29 is confusing. What is "an essential distinction in the competitiveness of Agreement offers"? If returns to other conservation programs can no longer compete with returns after conversion to cropland, then avoiding conversion is no longer a 'common practice', and perhaps the parcel of land should be eligible for inclusion under ACoGS?	The third bullet is definitely wordy. An essential distinction could include the scenario provided by the reviewers, and would make the parcel of land eligible for ACoGS. Any change in Conservation Program administration/returns that would limit the attractiveness of the existing program relative to cropland conversion would be considered an "essential distinction".	☑	
E.2	What is meant by 'carbon finance' in the last bullet? Presumably this is a supplementary offset project. Please clarify.	Carbon finance is the payment to the landowner from ERT sales, which will be separate from the easement payment.	☑	n/a	n/a	
E.2	Seems appropriate that the criteria (top half p. 24) target rangeland that might not otherwise be protected from conversion.	Correct, that is the intent of the criteria.	☑	n/a	n/a	

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E.3	Unclear how the 'highest and best use' might differ between identified and unidentified LU converters or agents. Is it likely that conversion to residential use (rural residential, hobby farms, vacation properties), or even to suburban development would make the rangeland ineligible for the ACoGS protocol, because the land values tend to be so much higher than that associated with use for commercial agriculture?	There is no difference in the application of 'highest and best use' for identified and unidentified agents. Correct, an identified 'highest and best use' other than cropland would not eligible for use with the ACoGS methodology.	Clarify second sentence under E.3 by deleting "for both UA and IA', adding a period and starting a new sentence something to the effect that "In section D conversion of grassland or shrubland to annual cropland is identified as the only LU/LC change that shall be considered." (if this is correct?)	E.3 was edited by deleting "for both UA and IA", and beginning a new sentence beginning with "Section D". The specification of the eligible land use was not specified, as the intent is to consider all eligible land uses.	☑	

F. Quantification of GHG Emission Reductions and Removals

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F.1	An obvious pitfall to estimating baseline emissions is that the conversion of perennial rangeland to annual cropland is a transitional phase during which ecosystem processes adjust to an entirely new regime. Much of the research effort on agricultural GHG emissions has been concerned with cropping systems that are at some sort of quasi-steady-state, far removed from the transitional period when natural or grazing ecosystems were converted to agricultural ones. Fortunately, measurements of changes in SOC stocks in carefully selected systems provide an integrated assessment of CO_2 emissions, but there is a paucity of information on emissions of non-CO_2 GHG during the conversion of perennial rangeland to annual cropland.	The authors agree with this comment, that there is a general lack of existing research and flux measurement of SOC losses immediately following conversion for almost all systems. However, in terms of GHG accounting and crediting, the use of conservative transition and oxidation rates that reach the more studied steady-state will not lead to an overestimation of emissions.	Agreed. The paper by Ruan and Robertson (2013. Global Chg. Biol. *op cit*, since we all like Latin) contains recent estimates.	Thanks for the reference.	☑	
F.1	For clarity, more work is required to ensure consistency among the equations. In Eq0.1 the P and p need to be placed above & below the summation sign, and both should be defined (e.g. P is the total number of fields and p is for a specific individual field). But if the baseline field is hypothetical (unlike a participant's field where conversion has been avoided and LU/LC remains unchanged), is there still a need to sum over many hypothetical alternatives?	The P and p in Eq 0.1 have been corrected and a definition for p added. Other inconsistencies among equations have likewise been cleaned up. Each participant field is the same for the project and the baseline, but it is the activities in the hypothetical baseline that are estimated in F.1. The summation is of the multiple participant fields grouped under a single project, which we hope is made clearer by the text added to Eq. 0.1 and 0.2.	A cursory look suggests that the equations have been improved, but the complexity is so great that errors inevitably will creep in. A more efficient way to ensure the veracity of the equations used to estimates GHG emissions is to provide a detailed example, and calculate the resulting emissions. A worked example is required before any of us might have confidence in	Please see spreadsheet with worked example.	Thanks for the spreadsheet. We have been unable to verify the calculations, but believe careful inspection of those is essential to formulate a credible GHG offset	

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			the methodology.		program.	
F.1	How does baseline differ from baseline scenario? Does the term scenario imply that it is some sort of hypothetical estimate of GHG had the conversion not been avoided?	The baseline and the baseline scenario are the same thing.		Can this comment be closed?	☑	
F.1	BEy is for the entire project region, right? I would also require information on the **area** in hectares, as I think it is the GHG emissions per unit area that is relevant to estimating ERTs, and essential to compare among GHG mitigation strategies.	Correct, BEy is for the entire project region. Area units are intentionally excluded to allow summation at the participant field level, the unit where uniform management practices will be implemented and ERTs ultimately issued. It would still be possible to derive a per unit area emission estimate.	Both GHG fluxes and terrestrial C stocks typically are measured on the basis of area. For technical reviewers to determine whether flux or stock estimates seem reasonable, we need to be able to convert them back to a per unit area basis. That is what we measure, and that is how a vast majority of the research is reported.	The authors recognize the attractiveness of area based stocks and fluxes. BEy is measured at a field basis, but the calculation of C stocks and fluxes can easily be determined on an area basis. For example, the C stocks include an area multiplier. Although the fluxes are calculated at a field level, a per hectare or acre value will likely be used to scale up the calculation to the field level.	Would it be reasonable to require that the applicable area in Ha be reported whenever an aggregate value is reported? This may help to expose potential errors.	Agreed, the following text has been added to the first paragraph of G.1 Data and Parameters Available at Validation: *Project proponents are strongly encouraged to maintain area-based parameters in per Hectare units as well as the unit specified in this methodology, typically field p, to assist validation and verification events.*
F.1	It is essential to explicitly define time zero (y=0); I suggest this be the year when LU/LC would be changed hypothetically, and the start of avoided conversion.	Time y=0 has been defined as the project start date. Depending on when a participant field is enrolled in the program, and when it would be converted, the start of avoided conversion will vary by field. The Equations in F.1 are designed to accommodate for this by summing across fields.	Hypothetically then, some fields might have been converted in 2014, and others in 2015?	Correct. Depending on when the field is enrolled in the program will dictate when it will convert. The methodology is meant to allow ongoing enrollment, hence the conversion in 2014 or 2015.	☑	

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F.1	I find the parameter symbols cumbersome, because one to three characters are used to designate each parameter (wordiness prevails), and these require even further elaboration with 4 to 12 subscript characters and punctuation marks.	It is agreed that the parameters can be cumbersome at times, but this notation is common among GHG quantification methodologies.	A worked example will be essential to assess whether the equations might provide realistic estimates. Eq.0.2 still contains $E_{BB, BL_{p,y}}$ (cumbersome, no?), but non-CO_2 from biomass burning was to have been regarded as negligible (evidence base too scant), as per page 21.	Worked example provided. Cumbersome indeed. $E_{BB, BL_{p,y}}$ has been removed from Eq.0.2.	☑	
F.1.1	Models are only as good as the parameterization, initialization and calibration used to set them up. Typically pool sizes must be estimated to initialize the models, but changes in C pools may be estimated by integrating predicted CO_2 emissions. In practice, models may provide a veneer of scientific authority or rigor while concealing the messy and gap-ridden evidence-base used to estimate GHG emissions. Despite these weaknesses, given the scarcity of data on non-CO_2 GHG emissions during the LU/LC transition models likely will be required. The proposition that "estimation procedures for each pool and source will indicate whether models may be used for their estimation" seems circular and irrational. Is this some sort of attempt to justify model use on the basis of concordance between measured and predicted values?	Additional model requirements have been added to F.1.1 regarding model quality criteria, validation requirements, etc. The reference to "estimation procedures for each pool and source…" is in reference to the guidance provided in the methodology, e.g. models are allowable for soil emissions, biomass but not enteric fermentation.	It would be more transparent to acknowledge potential weaknesses in models, and the importance of thoughtful parameterization, initialization and calibration. Of course a model, even if only simple 'emission factors', must be used to estimate enteric CH_4 emission, as this is difficult and expensive to measure directly.	A reference to the Chamberlain et al. 2011 paper was added as an example of thoughtful model use. The authors feel the existing language provides the criteria for thoughtful model parameterization, initialization and calibration.	☑	
F.1.1	What are the quantifiable criteria (if any) for the validation of models for the project region? Any data being used to calibrate a model (p. 27) must be peer reviewed and some standard of quality be assessed. I have seen numerous sets of data used to calibrate a model that were not scientifically collected and would not have met a peer review process. Listing the criteria probably is a good idea, but some of them make little sense, and taken together will likely exclude most models (i.e. the list may be too restrictive). Little sense: soil dynamics implies geomorphological processes; perhaps soil organic matter dynamics was intended. Overly restrictive: output of estimated means &	Additional guidance on the rigor of allowable data for model validation has been provided. 'Soil dynamics' has been changed to soil organic matter. Mean and variance requirements have also been edited to "Output from models should include estimates of uncertainties associated with all pools and sources. In cases where variances are not included in model outputs, additional uncertainty analyses should be performed (e.g., Monte Carlo simulations)."	A stringent list of criteria to determine whether or not a model may be trusted likely will prove too restrictive. For example, it may be unreasonable to have a model validated for climate (not weather) local to every 'participant field'. One of the more useful things about models is that they might allow us to interpolate GHG estimates for climates that fall somewhere between the extremes at which the model has been validated. Required variance estimates have been clarified. Most of the models listed are deterministic rather than stochastic, so	Thanks for the further clarifications and reference to the Chamberlain et al paper. A reference to Chamberlain et al. 2011 has been added to the first paragraph of F.1.1.	☑	

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	variances; this could eliminate many useful models that are deterministic, even though multiple runs with varying inputs may provide crude indications of variance.		multiple models runs likely will be required to predict the output range. It would be pertinent to cite the paper by Chamberlain et al. (2011 *op. cit.*) as an example of how models might be used.			
F.1.2	The sequence in which parameters are defined (if at all) does not correspond to their presentation in the equations (e.g. FCp,y on p. 27 does not appear until 3 pages later in Eq.0.5; at least provide the relevant equation number with this early delineation; also this parameter must not be used as a cumulative proportion, because emissions change rapidly during the transition phase).	Equation numbers have been added to FCp,y on page 27. FCp,y is only applied to biomass estimates, and not soil carbon. Above and below ground biomass pools become zero once converted, and therefore not cumulative. A separate parameter, FCt,y, is applied to Soil Carbon and is not cumulative.	In paragraphs 3 and 4 on p. 33 eliminate “addressing APC”, as APC (=avoided planned conversion) now is redundant (i.e. definition for APC eliminated on p. 5).	Edits performed.	☑	
F.1.2	Wordiness: All agents are APC or avoided planned conversion (planned also seems redundant), although some agents are identified, whereas others are unidentified, so why not simply use IA or UA?	Reference to APC-IA or APC-UA have been changed to IA and UA.	☑ (but see above)	n/a	n/a	
F.1.2	Wouldn’t it make more sense to handle piecemeal conversion by sub-dividing into distinct strata? Even better, simply assume that the conversion (which is hypothetical in any case, as conversion is to be avoided) of the entire participant field occurs in a single year – even instantaneously if that simplifies things.	It is anticipated that in most regions, 100% of a participant field would be converted in a single year, and it will be easy for a Project Proponent to demonstrate this with the current approach. The additional qualifiers for piecemeal conversion were included for the hypothetical scenario of a large ranch which could not be realistically converted in a single year.	Again, this complexity seems to be an inappropriate carry-over from offset projects developed for forested systems typically with larger tracts of land, fewer owners and agents, and more spatial and temporal heterogeneity. For grasslands it would be more appropriate to assume entire participant fields are converted within a single year, and add the provision that large ranches may be subdivided into smaller ‘participant fields’ if conversion within a single year is unfeasible.	The authors agree that the proposed guidance may be unrealistic for most grassland scenarios, and could easily be addressed with subdividing into smaller participant fields. This option would still be possible for Project Proponents under the current guidance, and as other fields previously converted are likely of an average participant field size, would accomplish the same objective. However, the piecemeal conversion requirement for large tracts would still prove useful in preventing large 10,000+ acre ranches from claims of conversion in a single year. Even if subdivided into	☑	

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				multiple participant fields, it's unlikely that local labor/machinery supplies would be sufficient to accomplish such a large task.		
F.1.2	To ensure additionality, would it not be reasonable to specify some sort of spatial off-set (common in forestry) of converted areas from deep ravines, wetlands, streams, etc.? Since existing land available for conversion is likely to be marginal, the non-convertible ravines, riparian areas, bedrock outcrops, etc. must be thoughtfully excluded from participant fields.	The appraisal will address this by identifying areas suitable for conversion. Areas that are too steep, moist, rocky, etc., would be deemed unsuitable for production and excluded from the participant field. Additionally, forested riparian areas would be excluded by the Forest Land definition in A.3.	☑ (but perhaps the likely ineligibility of such areas should be acknowledged, perhaps in the intro to section D on p. 23)	n/a	n/a	
F.1.2	Slowly I'm grasping the distinction among participant (rangeland manager/user), agent (converter) and proponent (aggregator). The proponent deals with aggregates and cumulatives, but fundamentally the GHG equations seem to start with a specific stratum in a certain participant's field. The GHG estimates are not based on some sort of mean aggregate for all participant fields within a project region coordinated by a proponent, or are they?	The GHG estimates may be a mean aggregate, or an estimate based on field-level measurements. The intent is to allow the greatest amount of flexibility for project developers, recognizing there is a great deal in variability of existing data and measurement costs for different regions and GHG sources.	☑ Intent to provide flexibility seems reasonable, otherwise it will be very difficult to assemble projects (project developer = project proponent?).	Yes – Project Proponent is the ACR account holder. This may be the rangeland owner/manager themselves; a project developer working with a single rangeland owner/manager; or a project developer/aggregator aggregating multiple project participants. We have incorporated this clarification into the definition of Project Proponent in A.3.	☑	
F.1.2	Would it not be useful to specify a maximum area of a participant field to be 65 Ha (160 acres), and the minimum area of any particular stratum to be perhaps 2 Ha? The larger limit corresponds to a common increment used in traditional land surveys, and the smaller limit might help exclude negligible areas typified by complex landscapes, management, and ownership.	For defined regions it would be useful to define maximum-minimum project areas, however, the typical unit of conversion will likely vary by region, e.g. smaller pastures in the east vs. large ranches in the west. The methodology was designed to be broadly applicable across regions.	Some maximum area would help ensure a single set of flux estimates of C stock are not recklessly applied to vast tracts of land, and some minimum area might help exclude trivial areas and provide additional assurance of 'additionality', because with very small areas are becoming increasingly uneconomic to crop with current technology.	The authors still feel that there are more disadvantages to defining maximum/minimum field areas than advantages. The concerns raised about minimum areas would be addressed through the appraisal and baseline consideration of other conversions. The GHG estimation concerns would have to be justified by the	☑	

<table>
<tr><th></th><th>1st review</th><th>Response</th><th>2nd review</th><th>Response</th><th>Final Review</th><th>Final Response</th></tr>
<tr><td></td><td></td><td></td><td></td><td>Project Proponent during project verification.</td><td></td><td></td></tr>
<tr><td>F.1.3</td><td>Again, why 40%?

A simple ‘truth table’ might be useful to distinguish among errors:

<table><tr><th>Projected Land Use</th><th>Actual Land Use</th><th></th></tr><tr><td></td><td>converted</td><td>conversion avoided</td></tr><tr><td>best use is cropland</td><td>✓ (no error)</td><td>Type 1</td></tr><tr><td>likely to remain as rangeland</td><td>Type 2</td><td>✓ (no error)</td></tr></table>
The ACoGS is designed to avoid conversion of land ‘best used’ as cropland. In situations (ideally rare Type 1 errors) where expected conversion fails to occur in the absence of ACoGS, the emission reductions attributed to ACoGS lands must be discounted.

No discount is applied if the converting agent is identified or if the value of the cropland is at least twice that of the rangeland. If the converting agent is unidentified and the value of the cropland is 1.4 to 1.99 greater than the rangeland, the discount rate is 0.5 (i.e. reductions in GHG from avoided conversion are less certain, because it is less certain that the rangeland actually would have been converted).

This approach seems to rely heavily on a close correspondence between market value and production value of the land.</td><td>See response in A.5 regarding 40%.

Correct, the approach does assume that for eligible projects there will be a close correlation between production value and market value. In locations where market value is driven by non-production values, e.g. development, then a highest and best use other than crop production will be identified, and therefore ineligible for use with the methodology.</td><td>The lower threshold has been handled adequately (see previous discussion).

To reiterate previous point, even when farmland is unlikely to be subject to urban, industrial or residential development, the market value often includes a considerable proportion of speculative value, possibly reflecting scarcity, which is disconnected with productive value. According to Doye and Brorsen (2011 Choices vol. 26 no. 2) the market value of pasture land has risen dramatically in recent years, whereas the rental value has not. The latter more closely follows the value of livestock products, such that the value for livestock production is increasingly diverging from the market value.

Generally the discounting approach for unidentified agents of conversion seems reasonable.

A reference appears to be missing from the second paragraph on p. 34 (section F.1.3)</td><td>The additional explanation of speculative value is appreciated. Plantinga, Lubowski and Stavins 2002 (Journal of Urban Economics 52:561-581) took a more in-depth look at sources of land value at the state level and found similar influence of development potential on market value, especially along the East Coast of the US. However, development share of land value was typically less than 5% of total agricultural land value in most grassland-dominant states, e.g. 0% for the Dakotas. Assuming the development value is equally realized in both crop and pasture, the relative value between the agricultural uses would still be relevant.

No references are missing from the second paragraph of section F.1.3.</td><td>☑</td><td></td></tr>
<tr><td>F.1.4</td><td>Since the baseline refers to converted cropland, there should be negligible above-ground biomass (AGB) persisting from the pre-existing rangeland. Since rangeland AGB is the first be converted to a mixture SOC and CO_2, this seems unnecessarily complicated.

We question why the methodology must account for</td><td>Yes, not all of the participant field may be converted in year 1. Additionally, for UA conversion occurs in project year 2. An estimate of AGBgrass is also necessary if the loss of AGB from conversion to annual croplands is to be included. Further, AGB is an optional pool that</td><td>☑ Good explanation. Conceivable that in shrublands it makes sense to account for AGB separately, but for grasslands conversion essentially merges AGB, BGB and SOC into a single pool that is rapidly decomposable.</td><td>n/a</td><td>n/a</td><td></td></tr>
</table>

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	rangeland AGB when the rangeland has been converted and so ceases to exist under 'baseline' conditions. Subsequently in Eq.0.5 the answer seems to be perhaps that only a fraction of the rangeland has been converted. I question whether such complexity is warranted, and would argue that if it is, the various levels of stratification and fractions of conversion, etc. need to be described explicitly.	project developers may elect to ignore. It is anticipated this would be the case for most rangeland systems, but not the case for shrubland systems with substantial AGB.				
F.1.4.1	Pg 29. I don't agree, and neither does published data, that all of the C in rangeland AGB will be converted to atmospheric CO_2 in the first year of conversion from grassland to croplands. Conversion to annual cropland transfers rangeland AGB to the soil (deposited on the surface, and mixed into the surface soil layer to varying degrees) where it is released to the atmosphere as CO_2 over a period of several years (say 5 to 25 yrs.). The simple box diagram in comment F.1.6 (see below) is an attempt to show this C stock transformation/translocation. You may have 20-40% lost the first year but it may take 30 years for all of the inherent soil C pool (that which was originally accumulated under or inherited from the rangeland and is susceptible to loss under annual cropland) to be lost.	A non-linear conversion rate for AGB has been added to account for the non-instantaneous decay rate of AGB.	The proposed first order decay pattern seems reasonable, but the coefficients must be defined explicitly. The coefficient 0.77 specifies that AGB has a half-life of 0.9 years after conversion. We guess that y=calendar year under consideration (say 2016, not y=0), t=year of conversion (say 2014 = time zero), -0.77 is the first order decay coefficient with units of year^{-1}; thus $e^{-0.77*(2016-2014)} = 0.21$ = proportion AGB decomposed since inception of the project. We suspect this could be in error, as the decay function estimates cumulative loss, whereas the summation sign implies some sort of an annual increment.	Note that there are two subscripts denoting time, one that denotes the 'year' of the baseline. The other denotes the 'time' (in years) since conversion. Since it is possible that only a fraction of the Participant Field is converted in a given year, the exponential decay function must be calculated separately for each portion of the field that is converted at a different time, then summed across these portions (but is not summed across years, which would be incorrect, as the reviewer points out). We can see how this is confusing. We have attempted to clarify this in the text. The parameter definition has also been edited to define coefficient more explicitly.	☑	
F.1.4.1	Again, footnote 6 (p. 29) seems to be a technicality, possibly carried forward from an offset protocol based on forestry. Converted grassland and shrubland are unlikely to have walnut trees that are liable to be converted to heirloom furniture. The need to define shrub and	The discussion of tree biomass is in recognition of treelines, savannahs, scrub junipers, etc. may be present at a project site and that project proponents would not be able to assume 100% loss at time of conversion. A definition of 'tree' has	☑ At the top of page 36, avoid the agronomic colloquialism "burning down", as this is too easily confused with burning by fire, which may have some role in managing	n/a	n/a	

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	distinguish it from tree should be considered. The persistence of rangeland AGB is likely to be 0.3 to 3 yrs, as it is rapidly converted to atmospheric CO_2 or surface litter or soil organic matter (consisting of a diversity of components ranging from fresh AGB to centuries old humus) by herbicides, fire and mechanical disturbance (e.g. tillage using a breaking plow or disk, bulldozing shrub into windrows). Given today's technology, and perhaps a maximum field size of 65 Ha, it is unclear why conversion must be spread over several years. If this is essential, it might be better to treat each annual block of converted land as a separate stratum, otherwise calculating SOC dynamics will become complicated.	been added to distinguish between trees and shrubs. A non-linear conversion factor for AGB has been added. It is anticipated that most projects will have complete conversion in a single year. The provisions for multiple years of conversion are meant to provide a conservative framework for large land parcels.	and converting grasslands and shrublands.			
F.1.4.2	In first paragraph, it may be more appropriate to just state the biomass values will conform to each crop year. Under annual cropping AGB production must be balanced by harvest and residue deposition (if that is what is meant by "mortality"), as there is no carryover of living biomass from one year to the next. The residues may persist, but if the intent is to make a simplifying assumption that there is no carry-over of above-ground C stock in annual cropland, it should be stated explicitly. In certain situations where semi-arid rangeland is converted to irrigated cropland, it is conceivable that C stocks might possibly even increase, but that might be rare.	First paragraph edited as suggested. Statement added to make explicit assumption that there is no carryover in aboveground biomass between years for annual cropland. It is recognized that in irrigated situations, carbon pools may increase. There would be no incentive to develop projects for these scenarios.	☑ Good explanation. It is essential to explicitly state (perhaps in section A?) what sorts of management practices may be permitted on project grassland – we might assume simple grazing and maybe herbicidal vegetation management, but not N fertilization or irrigation of any kind. If baseline cropland is irrigable and irrigation is not permitted on project grassland, then the highest and best use likely would be cropland, correct?		Still unclear on what management practices may be permitted on project grassland. Also see comments on sections A2 & A5.	Clarification added to applicability condition i to explicitly recognize haying as an eligible activity in the project scenario.
F.1.4.2	Top of p. 31: "or to populate the model estimate" is wordy and confusing. While models can be valuable, essential even, they must not be used to conceal crude assumptions, scant evidence bases, and the fact that model outputs rarely are superior to basic data on net primary production, plant partitioning, and harvest indices.	The portion of the sentence in question has been deleted.	☑ Also, in 3rd paragraph on p. 37 it is good to see default values for harvest index (eliminate ratio). Clearly define harvest index as the ratios of grain or beans to total <u>above-ground</u> biomass.	n/a	n/a	
F.1.4.2	Need to provide stratification guidelines.	Stratification guidelines have been added; see new text in B.1.1.	See comments for sections B.1.1.1 and F.1.2.	Comments in B.1.1.1 and F.1.2 have been addressed.	☑	

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F.1.5	Decay of below-ground biomass (BGB) from perennial rangeland may be prolonged; BGB is converted to necromass (dead material, practically indistinguishable from SOM) by the LU/LC change, and subsequent decomposition may be elevated for a decade or two.	A non-linear decay parameter for BGB has been added.	See previous comments on decay coefficient for section F.1.4.1. In Eq.0.9 k = 1.41 $year^{-1}$, equating to a half-life of 0.49 years, which seems reasonable for BGB (although perhaps a bit too short for shrublands?).	Note that there are two subscripts denoting time, one that denotes the 'year' of the baseline. The other denotes the 'time' (in years) since conversion. Since it is possible that only a fraction of the Participant Field is converted in a given year, the exponential decay function must be calculated separately for each portion of the field that is converted at a different time, then summed across these portions (but is not summed across years, which would be incorrect, as the reviewer points out). We can see how this is confusing. We have attempted to clarify this in the text. The parameter definition has also been edited to define coefficient more explicitly.	☑	
F.1.5	Clarify in the 1st paragraph of F.1.5: replace "through the application of" with "by multiplying".	Edit performed.	☑ Also, on p. 38 replace Carbon stocking with Carbon stocks	Thanks for catching, edit made.	☑	
F.1.5	Users of protocols such as this must be aware that the root:shoot ratios for biomass dry matter often are not equivalent to those for biomass carbon. Theoretically the [C] in AGB and BGB should be comparable, but in practice those for BGB often are smaller, as they are diluted by mineral soil (if a scrupulous job of root washing is done to eliminate all mineral soil, root losses become unacceptable). For example, with a dry matter BGB/AGB ratio of 0.8 with 46% C in the AGB and 23% C in the BGB, the	References and values have been added for appropriate root:shoot and carbon to dry matter ratios. Annual increments of BGB stocks are not estimated, as the BGB pool is assumed to be at a steady state.	Would it make sense to provide default shoot:root values for estimating BGB in grasslands? Perhaps some default values or algorithms may be drawn from Jackson et al. 1996 (Oecologia 108:389-411) or from Gill et al 2002. (Global Ecol. & Biogeogr. 11:79-86).	The authors have already included a default root:shoot value for grassland BGB in section F.2.2. A reference to the Gill et al. 2002 paper was added.	The proposed ratios on page 55 are reported to four significant digits, when only two are warranted, otherwise ☑	Thanks for catching this, the ratios on p. 55 have been edited.

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	BGB_C/AGB_C ratio is 0.4. Measurements of root:shoot ratios are fraught with errors and distinguishing the annual increment of BGB from the standing perennial stock of BGB in perennial rangeland is even more problematic.					
F.1.5.1	Clarify the subdivisions among strata ($F_{p,i,y}$) and among fractions converted (FCp,y), and consider whether these two sub-division parameters might be merged (e.g. possibly stipulate conversion by stratum?).	In general, the equations and parameters were structured as to allow GHG quantification and credit issuance to the scale of the participant field. The FCp,y parameter serves to address the proportion of field that has been converted, specifically to address the scenario where 100% of the field is not converted at once. The parameter Fp,i,y is used to differentiate pools by strata for fields with multiple strata.	A worked example will be required to check for errors in the proposed set of equations for estimating GHG emissions.	See spreadsheet with worked example.	Thanks for the spreadsheet. We have been unable to verify the calculations, but believe careful inspection of those is essential to formulate a credible GHG offset program.	
F.1.5.1	Since ACoGS applies to grassland and shrubland, is it essential to exclude tree biomass? If so, some distinction should be made between trees and shrubs. At the forest-grassland ecotone, tree encroachment (and retreat) seems to be a natural and common ecological process (driven by grazing, fire, climate…).	A distinction between trees and shrubs has been added with definitions in A.3. Tree biomass is excluded because quantification would entail a different set of quantifications. Systems with sufficient tree biomass to warrant quantification would be better addressed with a REDD (avoided conversion of forest to non-forest) methodology. As it is conservative to exclude potential GHG gains from the project activities, they have been conservatively excluded.	Will brush control (e.g. by prescribed fire, herbicides) be permitted on project lands? Encroaching aspen, for example, starts as shrubs, and may develop into trees if left unchecked. This may have implications for forage production, wildlife habitat and other ecological goods and services.	Yes, brush control is permitted. Control of encroachment is also addressed with Applicability Condition d): Land may remain in use for livestock grazing and be subject to prescribed burning or wildfires during the project scenario, so long as prescribed burning conforms to current best management practices in the Project Region and does not knowingly contribute to the succession of native Grasslands or Shrublands to an alternative vegetation type.	☑	

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F.1.5.2	Potential pitfalls of using root:shoot ratios have been noted above. Perhaps the depth considered should be prescribed explicitly. Few data are available on SOC or BGB stock below a depth of 1 m, and the dynamics of C in these stocks is even less certain. Pg 33. What about the use of available data. Below-ground C stocks may not be accurately estimated based on above-ground biomass; particularly in complex native grassland ecosystems.	Specification of pool depth was considered but ultimately excluded in consideration that data availability and soils will vary by region and system, and that allowing the project proponent to justify the pool depth provided the most flexibility. For example, a 1m requirement may work for many regions, but in areas of shallow soils, a 15 or 30cm depth may be sufficient. Similar to AGB, the option to use available data for BGB estimation was added to sections F.1.5.1, F.1.5.2 and F.2.2. (Note that these edits do not appear in 'Track Changes' as the changes had to be accepted in order to save the document).	☑ Good explanation. The provision for such flexibility is appropriate. The depth considered may be adjusted as appropriate, but the depth under consideration must be recorded and carefully documented.	n/a	n/a	
F.1.6	To be useful, regional soil C inventories must [use] detailed information of LU/LC and management history. Need to be explicit on what is meant by 'materially similar' (e.g., soil type, land use, MAP, MAT, etc.). Direct measurements of existing cropland in the region might provide some insight to the possible influence of conversion.	Regional soil C inventories, i.e. SSURGO, do not account for LU/LC. Additional guidance has been added for regional soil C inventories. Materially similar is further clarified with the addition of "e.g. soiltype and climate". The authors agree that direct measurements as part of a pair-wise study will provide important insight into conversion soil dynamics.	☑	n/a	n/a	
F.1.6	The document should include explicit references or sources to 'gray literature', such as ISO protocols, ACR Tools, etc.	A reference to the ACR tool and ISO document were added to section H. References.	☑	n/a	n/a	
F.1.6	Perhaps the depth range should be confined between 0.3 and 1.0 m, with the actual depth selected for calculating avoided GHG emissions to be specified by the proponent?	See response to comment F.1.5.2. The authors feel it is best to preserve flexibility, leaving the burden of proof and decision of measurement expenses, to the project proponent (to justify to the validation/verification body).	This flexibility seems sensible, but it is essential for the depth under consideration to be fully documented and justified, otherwise it will be difficult to determine whether the estimated C stocks are reasonable.	Agreed, the second paragraph of F.1.6 requires such justification, i.e. "The affected depth chosen for sampling shall be justified to the validator."	☑	
F.1.6	Check syntax for Σ sign: should it be $T \leq 20$ at top & t at bottom (in definition of t, could indicate for 0 through t years, up to 20 years)?	Edit made.	It might help to have a clear definition of the time variable. Originally it seemed as if time was defined relative to avoided	The definition of t provided in Eq. 11, has been added to Eq. 0.5 and 0.9.	☑	

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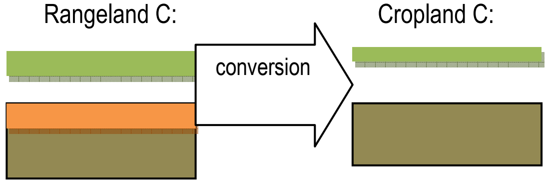
			conversion at time zero. Now Eq.0.5 and Eq.0.9, for example have both y and t variables – please define and distinguish. In the last paragraph on p. 42, what does Di = 20 represent?	D = 20 represents the transition period until the new SOC pool level is achieved, as defined in Eq. 0.12.		
F.1.6	The various approaches to prescribing the emission factors ($EF_{t,i,y}$) seem to be described adequately, but I would have liked to have seen some examples. I am unfamiliar with partitioning this factor among the effects of land use, management and OM inputs; perhaps a detailed source for the AFOLU2006 report would help.	A footnote was added to the AFOLU 2006 document. The relevant equation and page numbers are included in the text.	Do the summation limits B and b used in Eq.0.6, 0.10 and 0.11 refer to contrasting plant biomass types? How many contrasting biomass categories are required? Is it acceptable to use composite estimates of grassland forage (an admixture of grasses, forbs, sedges, etc.)	Yes, B and b are biomass types. It is envisioned that a composite will be typically used for grassland systems. The biomass distinctions are primarily used to address crop systems.	☑	
F.1.6	I'm not entirely clear on the distinction, if any, between SOC and C stocks in the BGB. Perhaps a simple box diagram with AGB in green, BGB in orange & SOC in brown (range AGB & BGB merged into cropland SOC, leading to a prolonged elevation of soil CO_2 emissions?): Rangeland C: Cropland C: 	Guidance for BGB estimation is provided in F.1.5.1, and is a distinct pool from SOC. BGB (non-tree) is treated as a separate pool in ACR forest methodologies and is generally recognized as a separate pool in other AFOLU methodologies.	Under baseline (converted) conditions, does grassland BGB cease to exist upon conversion, or does it persist until decomposed to CO_2?	Persists until decomposed, per edits in F.1.5.1.	In practice it will be very difficult to distinguish detrital material from the roots of grasses after the land has been converted for annual cropping. The roots of perennial grasses will become inextricably mixed with SOC as depicted in the simple box diagram at the left.	The relevant question is not whether these pools can be perfectly distinguished in converted cropland, but whether any carbon will be missed (double counting of carbon stocks in cropland would be OK, since that would make estimates of loss conservative). Both empirical estimates and models will detect detritus in either the root biomass pool or the SOC pool, and so will

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						not 'miss' any carbon that should be accounted for in cropland. Specifically, it is difficult to imagine roots that are so small they are not counted as biomass in decomposition experiments, but are so large they are removed from SOC samples, which is what would be required to end up with 'missing carbon' from overall belowground cropland pools.
F.1.7	In this section and elsewhere, the global warming potentials (GWP, 100 yr time horizon) for N_2O (298) and CH_4 (25) need to be updated. IPCC (Intergovernmental Panel on Climate Change). 2007. Climate change 2007: The physical science basis. 4th Assessment Report. Accessed at: www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml (verified 2 Feb 2013).	Per direction from ACR, the second assessment report 100-year GWP values have been retained. ACR recognizes IPCC has updated the GWP numbers, but ACR and virtually all other standards (and the EPA national inventory) have stayed with the 2nd Assessment Report values for consistency and fungibility of credits across years.	This convention seems at odds with the instruction to use the most current version of assorted 'ACR tools', whatever the version may be.	It is not at odds. The most current version of the *ACR Standard* is v2.1, and requires use of the SAR-100 GWP values.	☑	
F.1.7	In earlier 'IPCC methodologies' special consideration was devoted to leakage of N_2O during biological N fixation, but now this is regarded as misleading (culminating in double counting). Now greater N_2O emissions sometimes observed from soils that had produced N-fixing crops are attributed to the rapid decay of legume necromass with	$F_{BL,NF_{p,y}}$, Mass of N in plant residues (above and below ground), including N-fixing plants returned to soils annually in year t, t N (yr^{-1}) from Eq. 0.14, Eq. 0.17 and associated parameters, have been removed.	It is not entirely clear whether the additional N from biological N fixation and non-CO_2 gases associated with burning have been eliminated.	The remaining references to non-CO2 burning emissions and biological N fixation have been removed. The discussion of N fixing plants in the second paragraph of	☑	

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	greater N contents rather than to leakage during biological N fixation. As such, these emissions are accounted for as direct emissions associated with adding plant residues to soil. No specific reference to N-fixation is required.			Section F.1.7.1 has been edited to address these changes.		
F.1.7	For clarity, consider a simple dichotomy between synthetic fertilizer N, and organic N amendments (a majority associated with mechanically handled livestock manure, as opposed to feces and urine excreted by grazing livestock). Application of organic N fertilizer is rare, and encompassed within organic N amendments.	The synthetic and organic fertilizer N are derived from the CDM A/R tool, but IPCC Ch. 11 (Nitrogen emissions) separates organic amendments from livestock deposited dung and urine. Section F.1.7 and the Appendix have been edited to 'organic N amendments' as suggested. In the project scenario, where livestock are expected, livestock dung and urine is estimated separately from organic fertilizer, section F.2.5.1.	☑	n/a	n/a	
F.1.7	In the parameter definitions for Eq.13, "nitrogen containing content" is awkward and wordy.	Definitions changed to "N content" rather than "nitrogen containing content".	☑	n/a	n/a	
F.1.7.1	As indicated before, the rangeland-cropland transition is poorly researched and has a corresponding scant evidence-base. Historically, fertilizer N rates were relatively low during transition phase, as early crops benefitted from N released (mineralization) during decomposition of the AGB + BGB + SOC that had accumulated under perennial rangeland.	Agreed that the rangeland-cropland transition is poorly researched. Input from regional agronomists and/or extension agents can provide recommendations on N rates during transitions. For the conversion of restored grasslands, there are numerous Extension reports on management recommendations for conversion.	Consider citing some of the extension reports providing guidance on conversion management to help with selection of reasonable scenarios for the baseline condition.	This is a good suggestion and the citation of extension reports was initially considered by the authors. However, there was concern that the reports would become dated as technologies and practices change. It is the preference of the authors to not include these citations in the methodology.	☑	
F.1.7.1	The series of equation from Eq.0.14 through Eq.0.17 are very difficult to follow, as the parameter definitions span 1.5 pages in a seemingly chaotic sequence.	The sequence of parameters has been corrected so that their appearance is sequential with use in Equations 0.14 to 0.17.	☑	n/a	n/a	
F.1.7.1	Check Eq.0.17: is $A_{BLp,l,y}$ truly confined to legume crops as defined, or does it encompass all crops? Also seems strange to require some sort of a mean N content for AGB (N_{AGb}), and then to partition AGB, when most agronomic data especially for cereals have distinct (often 3 to 6 fold) [N] for the grain or harvested component and the straw or	See response to last comment on page 16- Equation in question has been deleted.	☑	n/a	n/a	

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	residues left on and in the soil. Similar concerns outlined previously regarding root:shoot dry matter versus C apply to N in the parameter R_{BGb}					
F.1.7.1	Pg 37. I have seen an abstract on a study that showed that even though a legume in native rangelands significantly increased soil N and C pools it did not affect N_2O emissions from those ecosystems.	It is envisioned that N2O emissions from most grassland systems will be negligible, but in the baseline/crop scenario the most likely legume will be soybeans, and therefore excluded. If it is possible to more explicitly exclude N plant emissions, as suggested previously, then this study could be used as justification.	If soybean is a typical crop, it should be included in the baseline scenario, and standard coefficients (IPCC?) will apply for estimating N_2O-derived from soy production. Discredited methods previously double counted legume-derived N_2O by assuming N_2O leakage during fixation by *Rhizobia*, and by deposition of legume N in the soil. Now we count only the latter source.	Correct, if soybeans are a crop in the baseline they will be identified and included in the baseline. References to N2O leakage from N-fixing plants have been removed, as have all emissions from legume crops (see comment and response above). Models would account for these emissions where soybeans are present. As previously stated in now deleted text from Section F1.7.1, it was optional to exclude these emissions as they would be greater in the baseline relative to the project. By default, these emissions are not excluded if a non-model accounting is utilized.	☑	
F.1.7.1	Consistency among equations needs to be improved: for example, J and K are defined, for Eq0.15 & Eq0.16, but B is not defined for Eq0.17; Eq.0.14 uses MW_{N_2O}, whereas Eq.0.19 uses 44/28, but these seem to be identical factors. Furthermore both represent the molecular weights of N_2O/N_2, not N_2O/N as specified on p. 38.	Eq. 17 has been removed. The use of MW_{N_2O} has been replaced with 44/28 throughout the methodology. Both the IPCC chapters and CDM tool referenced use N_2O/N, and not N_2O/N_2. N_2O/N has been left unedited to remain consistent with those sources.	☑ Now we understand, it is not the ratio of N_2O/N_2, but rather is the ratio of N_2O to N in the N_2O molecule, abbreviated as N_2O/N.	n/a	n/a	
F.1.7.2	In the definition for $Frac_{Leach}$, N added includes synthetic fertilizers, organic fertilizer N (although the term organic N amendment would better reflect the common use of soils as repositories for manure disposal), and annual N mineralization from SOM (this latter source is missing from the definition, but included inEq0.20)	Organic fertilizer N edited to organic N amendment. A definition for SOM was included but out of sequence. Parameters have been reorganized to be in sequence with use.	☑	n/a	n/a	

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F.1.8	Does anyone really know how important are the non-CO_2 emissions from biomass burning? I would guess this to be a carry-over from emission reduction protocols devised for forestry where fire can be an integral ecosystem function, rather than a transitory one. Admittedly, fire likely was a key component of the pre-settlement grasslands and shrublands on the North American Great Plains, but the evidence-base for including this must be dubious. If this is retained, clarify whether the emissions are the direct result of presumably abiotic processes during combustion (CH_4 production must vary widely with fire temperature and fuel water content?) or presumably from indirect effects of fire on biotic processes in the soil (post-fire perhaps a pulse of labile N fuels ammonification which competes with CH_4 consumption and which also boosts soil N_2O production?).	Fire emissions have been removed. Support that non-CO2 GHGs are minimal include: Goode et al. 1999 J. Geophys. Res. 104:17 Urbanksi, Hao and Baker 2009	☑ This recognizes that not all biomes are created equally. For the boreal forest, one must account for fire. Presently the evidence base for fire use/incidence and non-CO_2 GHG is too scant for grassland systems.	n/a	n/a	
F.1.9	It would seem reasonable that fossil fuel emissions from participant fields would be negligible relative to those on hypothetical avoided cropland. Are irrigation activities included in this procedure?	Agreed, which is why fossil fuel emissions are an optional source. Irrigation has been explicitly excluded as an eligible baseline practice.	Perhaps flood irrigation (see section A.5) needs to be changed to irrigation (all forms).	The limitation on flood irrigation is based on CDM A/R tool restrictions for N_2O emissions. It is not anticipated that irrigation of any form will be common on baseline lands given the expense and water availability. Fossil fuels used for irrigation would still be captured in the existing equations.	☑	
F.2	Summarize: 'the equation specifies that for each participant's field the GHG emissions are the annual change in AGB, BGB & SOC stocks, plus N_2O emissions associated with all (?) sources of N deposited on and in the soil, enteric CH_4, fossil fuel CO_2 used in ranch equipment, and non-CO_2 GHG from burning' The emphasis on SOC dynamics in the first paragraph should be balanced with added text on N_2O flux from soil	Additional text added as suggested.	It appears that Eq.22 for the project is somewhat analogous to Eq.0.2 for the baseline scenario. Why are enteric CH_4 emissions not counted in the baseline scenario?	Enteric CH_4 emissions are not included in the baseline scenario because it is not anticipated that livestock use of fields will be commonplace. Even where post harvesting foraging is common, exclusion of these emissions would be	☑	

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	and CH_4 from cattle.			considered conservative.		
F.2.1	Pg 44. The synthesis paper by Derner and Schuman 2007. J. Soil & Water Conservation. 62:77-85 does a good job of showing the effects of management and precipitation on C dynamics. Rangeland AGB also is highly dependent on plant phenology and grazing pressure or stocking rate. If AGB must be measured in a year having annual precipitation within 40% of the long-term mean, should not the timing of AGB measurement relative to plant phenology and grazing also be considered? Consider providing examples of biomass types: grasses, non-leguminous forbs, leguminous forbs, shrubs & trees?	Guidance added that AGB estimates should reflect peak annual biomass. Examples of biomass types added.	☑ The conservative estimate of peak AGB (peak annual above-ground plant biomass) must be based on properly-timed measurements given local climate.	n/a	n/a	
F.2.1	The parameter symbols are cumbersome: the *d* of *dm* $_{b,i,y=0}$ may be confused with the derivative in calculus, and the y=0 (but not in a dry year) and y-1 (provided y≥1) subscripts are easily misinterpreted.	The parameter dm has been edited to DM to clear any confusion with the derivative symbol. The y-1 subscript has been removed. The value for y=0 will be an average.	Eq.24 is analogous to Eq.0.7: both still include the term $dm_{b,y=0}$	OK, this time dm has really been edited to DM in Eq. 0.7, 0.24 and in the Appendix. Thanks for catching.	☑	
F.2.2	Something seems to be missing (maybe an operator?) at the end of 2nd paragraph under F.2.2 "appropriate root-to-shoot ratio C $_{AGBp,y}$ " Specify that this should be a root carbon to shoot carbon ratio, as distinct from a ratio of BGB to AGB "dry matter".	The root carbon-to-shoot carbon ratio parameter has replaced C $_{AGBp,y}$ at the end of the sentence in question. The root carbon-to-shoot carbon distinction was added as well.	☑ Good to see default root C to shoot C ratios.	n/a	n/a	
F.2.3	If SOC in the participant field is assumed to remain static, why does the stock difference appear to be included in Eq.0.24?	It does not. References to SOC in Eq.0.24 have been removed.	☑	n/a	n/a	
F.2.3	Pg 46. Adequate consideration has not been given to surface litter under F.2.3.	It is recognized that surface litter can contribute to SOM and SOC accumulation. As increases in SOC are not eligible under this methodology, litter impacts are not relevant to F.2.3.	Surface litter is a crucial and easily measured indicator of rangeland health. It seems curious to meticulously determine AGB when it may be largely released as CO_2 via livestock grazing in the year of livestock	The authors recognize that surface litter is an important aspect of rangeland health and soil carbon dynamics. However, as a carbon pool,	Surface litter is a small (but significant) pool, typically with a size on the same order	

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			production, whereas surface litter is not counted. Does surface litter contribute to baseline emissions shortly after conversion?	litter is relatively insignificant for both crop and grassland systems, e.g. IPCC 2006 AFOLU GL Chapter 5, Section 5.3.2 indicates that litter can be assumed to approach zero both before and after conversion of grassland to cropland. Where grassland litter decomposition following conversion is emitted, it is conservative to exclude these as the methodology is thereby undercounting total project emissions, or these emissions would already be counted in SOC changes post-conversion.	of magnitude as above- or below-ground plant biomass, both of which are accounted for in detail. Agreed that it is simpler and conservative (i.e. less likely to over-estimate GHG avoided when conversion is avoided) to exclude GHG from surface residues.	
F.2.3	Appears to be a mis-numbering, as the same heading number is assigned to SOC and Burning (Change designation to F.2.4 for Biomass burning).	The section number for Biomass Burning has been corrected to F.2.4, although this section was subsequently deleted at the reviewers' suggestion.	See comment below.	n/a	n/a	
F.2.3 (F.2.4)	Clarify by stating: "Prescribed fire must not be overused, in accordance with Applicability Condition j (section A.5)." Natural fire return time must be difficult to estimate (far more data are available for this in forested ecosystems)	Clarification added. Fire emissions have been removed.	The reviewers had questioned the contribution of burning to non-CO_2 emissions. Presumably the CO_2 emissions associated with biomass burning should be included, shouldn't they?	As the IPCC 2006 AFOLU GL includes no accounting for CO2 fire emissions and only for non-CO2 fire emissions, they were excluded initially from quantification. Per the GPG: CO_2 emissions from biomass burning in *Grassland Remaining Grassland* are not reported since they are largely balanced by the CO_2 that is reincorporated back into biomass via photosynthetic	☑ Essentially fire-derived CO_2 emissions are excluded for the same reason that CO_2 respired by grazing livestock is excluded.	

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				activity, within weeks to few years after burning.		
F.2.5	$E_{PR,N2Op,y}$ appears to be from total nitrogen deposition, not just from fertilizer application	Correct, definition for parameter has been corrected to "total nitrogen inputs'.	The application of synthetic fertilizer N could conceivably elevate N_2O emissions and stifle the benefits of the project.	True, this is why total N_2O emissions must be accounted for. Arguably, fertilizer application rates to pasture/rangeland will be lower than those of corn or other crops.	☑	
F.2.5.1	Since this already is a "backwards" (avoided loss) GHG mitigation scheme, reference to the baseline (i.e. the converted and cultivated annual cropland state) is confusing: this section should solely be concerned with the project (i.e. perennial rangeland state).	Typo corrected, reference should have been to 'project' and not 'baseline'. However, we also note that it is not anticipated that fertilizer applications will be common practice for the project scenario.	☑	n/a	n/a	
F.2.5.1	Equations and parameter definitions should be sub-divided to give the reader a fighting chance to follow the logic.	Sub-titles for equations have been added to aid readability.	☑ Subdivision by N_2O source is helpful.	n/a	n/a	
F.2.5.1	Pg 49. Does $F_{PR,NF_{p,y}}$ account for N inputs from legume fixation without being incorporated into the soil by tillage (this is what I assumed).	No, $F_{PR,NF_{p,y}}$,does not account for fixation. The equation is adapted from a tool for croplands.	Now we cannot locate this parameter – has it been changed to $F_{PR,SN_{p,y}}$ to reflect 'synthetic N' rather than 'N fertilizer'? This still requires clarification.	Correct, Nitrogen Fertilizer, "NF", was replaced with Synthetic N, or "SN".	OK, but still find it strange that one may apply 'organic fertilizer' (whatever that is) on project lands (grassland saved from conversion to annual cropland), but one may not apply manure (per applicability condition i on p. 10)	A clarification has been added to applicability condition i: *There are no restrictions on the application of synthetic or organic amendments, i.e. manure, in the baseline scenario.*
F.2.5.1	Unclear why N input from organic amendments is adjusted for ammonia volatilization (Eq.0.32), but the input excreted by grazing livestock (Eq.0.33) is not. Much	Ammonia volatilization of manure and urine is captured in section F2.5.2 Indirect Nitrogen emissions, as is done in [IPCC 2006 GL, eq. 10.25]	To work out an example and verify the calculations one would need a simple tabulation of all the various default emission	See worked example for additional questions.	Authors are advised to work with the spreadsheet to	

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	ammonia is volatilized from urine excreted by grazing livestock.	and 10.26.	factors. Now we see that NH_3 volatilization from the excreta of grazing livestock is captured in Eq.33.		check for errors and consistency; test rival scenarios, etc.	
F.2.5.1	Summation limits for Eq.0.32 should be K and k, not J and j For consistency should also define L and l (and maybe B & b too).	Summation corrected. Definition of L added.	☑	n/a	n/a	
F.2.5.1	Clarify the definition of MS_l; perhaps it accounts for situations when the livestock is on the rangeland for only a fraction of the year, rather than an entire year. The parameter definitions are difficult to follow, as M is used for a fraction and F are used for masses. I must not understand MS_l because Nex_l already appears to have been adjusted for the number of grazing days via Eq.0.35. Verify that this adjustment has not been made twice.	MS has been removed, as it is an artifact from the IPCC 2006 GL to account for various manure management systems within a sub-population of livestock. As all manure will be managed in the system, Per Applicability Condition i., 'Where livestock are present in the project scenario, manure may not be managed, stored, or dispersed in liquid form. Livestock shall be primarily forage fed and not managed in a confined area, e.g., feedlot.'. MS_l will always equal 1 and therefore has been removed.	☑	n/a	n/a	
F.2.5.1	Explain the concept of renewal of the participant field. Does this refer to prescribed burns, top-dressing with seeds; or even plow and re-seed? Again, reference to annual crops (for which $Frac_{Renew}$ = 1) is confusing, as most rangelands and shrublands where conversion is to be avoided have predominantly perennial vegetation (perhaps annual grassland is a rarity confined to California?). Also does the reference to "countries" imply that there is some unstated distinction between USA and Canada?	Agreed that the current use is confusing. Eq. 0.34 was designed for use in crop systems and has been removed. The reference to "countries" is a carryover from IPCC documents and has been deleted.	☑	n/a	n/a	
F.2.5.2	Inconsistencies on p. 51 are similar to those on p. 37: Eq.0.38 uses MW_{N_2O}, whereas Eq.0.37 uses 44/28, but these seem to be identical factors. Furthermore both represent the molecular weights of N_2O/N_2, not N_2O/N as specified on p. 52.	References to MW_{N_2O} have been replaced with 44/28. The use of N_2O/N is consistent with IPCC and CDM usage.	☑	n/a	n/a	
F.2.6.	Reword, try: 'Livestock emit CH_4 produced by enteric fermentation. Estimates of these CH_4 emissions are	Edits made as suggested, and additional text added on general enteric fermentation issues.	☑ Much improved introduction to this section.	n/a	n/a	

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	restricted to … (i.e. these exclude confined feedlots where manure is managed, as per Applicability …).' The first paragraph fails to capture issues related to enteric fermentation from cattle. Please consider reviewing helpful background by Kebreab et al. (2006) or Ominski and Witternberg (2006). Equations for enteric CH_4 seem OK.					
F.2.7	The management of grazing livestock on participant fields likely will entail minor amounts of fossil fuel use (e.g. for herding, maintenance of fencing, water supplies, etc.).	Fossil fuel emissions are an optional pool, as it assumed that fossil fuel use for crop production will exceed that of ranching activities.	☑ If fossil fuel emissions are counted in the baseline (can be appreciable), then they would be estimated for the project land as well (however small the latter might be).	n/a	n/a	
F.2.7	Should 'j' be 'v' in descriptors for second equation on p. 54? Should 'j' be 'v' in descriptors for Eq. 0.42?	References to "j" have been replaced with "v", the correct descriptor.	☑	n/a	n/a	
F.3	Move the "double counting explanation" up to the introductory section, so that the use of a maximum function is justified. Clearly define MAX in Eq.0.43.	The double counting explanation was left in its original location, but the following text was added to the introductory section: *In certain scenarios, and in the production of certain crops, it is possible that attempts to estimate activity shifting leakage will double count market leakage*. MAX is now defined in Eq. 0.43	It seems that figure F.1 has been simplified, but we still are baffled by this leakage section. Please provide examples to clarify the distinction between food and commodity crops, as in the present food system, transportation and industrial processing seems to be the norm. In particular, the place of livestock products (which may be derived from project lands) in this scheme is unclear.	It is envisioned that most leakage will be market based as driven by the demand and supporting policies for commodity crops. The distinction between food and commodity crops is currently demarcated by the requirement that commodity crops be traded on commodities future market. Currently, there are no vegetable or fruit, e.g. food crops, listed in a futures markets. In the odd instance where a local community is converting grassland to grow produce for local consumption, then the activity shifting leakage would be applicable. This would typically be expected in a	We remain uncertain about the implications of removing the decision tree section proposed by the authors.	The primary implication of the edited decision tree is that all leakage derived from the conversion of grasslands or shrublands to commodity crop production is market driven, even where the conversion agent is local. This change was made after further consideration was given to the motives and factors driving commodity crop

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				subsistence environment and not generally applicable to most of North America. The displacement of livestock in the baseline scenario is excluded, as this would be considered a form of positive leakage and therefore not eligible for inclusion. Leakage effects on corn/grain production from baseline activities on livestock markets are also not directly accounted for but would be so indirectly through their impact on commodity demand/price elasticities.		expansion, which are predominantly market-based.
F.3.1	The use of Latin phrases in sections 3.1, 3.2, and elsewhere is a nice touch, but may not resonate with all readers. Consider sticking to English usage for more obscure phrases.	Attempts to use Latin were minimal, except where the authors believed they were of common usage among the GHG methodology community or the relevant field of study.	☑ The GHG offset/methodology community has a unique set of jargon – slowly we're learning.	n/a	n/a	
F.3.2	Specify as Eq. 0.44 in line preceding the equation ("from Eq. 0.44, which is derived…").	Correction made.	☑	n/a	n/a	
F.3.2	Why will ACoGS "preclude marginal cropland from entering crop production" (p.57)? One might expect that by preventing the conversion of rangeland that is suitable for cropland (i.e. only land that produces at least 1.4 x more productive value as cropland rather than rangeland), ACoGS could actually have the unintended consequence of encouraging the cultivation of land that never should be cultivated.	ACoGS projects will preclude particular parcels from entering crop production, but it is recognized that these activities could have indirect effects on other parcels of land. This indirect effect is the intent of including a market leakage estimate.	The paper by Secchi et al. (2011, *op cit*) provides a clear distinction between changes at the intensive vs. extensive margins. This appears to be consistent with the description of market leakage LE_{My} at the top of page 68.	Thanks for the reference, glad to see that our terminology is consistent.	☑	
F.3.2	Statement about CRP lands not being utilized (p. 58) is not quite true because over the years many states have been allowed to use CRP lands for haying and/or grazing during drought.	Correct, tried to caveat with "typically". Further caveated by adding "although some emergency haying and grazing is allowed".	☑ Good improvement.	n/a	n/a	

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F.4	Some elaboration of the non-permanence concept is required. Perhaps it should be explained that the leakage and non-permanence deductions apply only to the carbon stock changes (i.e. stocks in AGB, BGB & SOC), because these stocks may be vulnerable to conversion to CO_2. In contrast, the non-CO_2 GHG are regarded as largely or completely (?) non-vulnerable (?).	Non-permanence is described in the ACR Forest Carbon Project Standard, Chapter 5.	We still think even a brief account of the non-permanence concept would be useful to help make the document more self-contained. Full details may be obtained from cited document for forested systems. Is there a fundamental difference between the permanence of CO_2 and non-CO_2 GHG?	The authors appreciate the suggestion to make the methodology more self-contained, but users and readers of the methodology will be familiar with the concept of non-permanence. As there is no text in this section, adding an account of non-permanence is not preferred by the authors. Further, other ACR methodologies, e.g. Rice, IFM, Livestock, do not include an account of non-permanence other than referencing the VCS/ACR tool. There is not a fundamental difference between CO_2 and non-CO_2 GHG, but rather between pools and sources. The distinction between pools (CO2) and sources (non-CO2) is in recognition that pools are potentially impermanent, whereas avoided emissions from sources cannot subsequently be reversed.	☑	

G. Monitoring

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G.1 &	The reviewers have not cross-referenced every parameter listed in the Appendix with its presumed use in the various equations. As indicated before,	The equations and parameter lists can be cumbersome at times, but this is common formatting for methodologies.	We still have not cross-referenced every parameter and variable definition, or verified internal consistency among units of measurement. A more efficient way of	Worked example provided.	Please verify consistency among units and	

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G.2	comprehension could be improved by adopting a more systematic and condensed parameter notation. The equations could be presented in smaller, more digestible, units, and the parameter details fully elaborated at that point (as opposed to an out-of-context list). Elaboration should be sufficiently detailed to allow tracing of unit consistency.	Unnecessary subscripts have been removed.	doing this is to collect a table of relevant emission coefficients, and proceed with formulating a worked example of the GHG reductions associated with avoided conversion for 5, 10, 20, 40 & 100 years.		across summation signs	
G.3	Is it presumed that the conversion agents (i.e. people with authority and $$ to hire operator, tractor & breaking plow) are the same people that subsequently farm the land to produce annual crops?	Correct.	☑	n/a	n/a	
G.3	What is the "time of validation"?	Time of validation refers to when the GHG Project Plan is validated by a third party validator.	☑ Will this document be important for use by any third party validator, or will some other set of instructions be used?	Yes, the third party validator will be validating the description of a specific project (GHG Project Plan) against this ACoGS methodology.	n/a	
G.3	Perhaps drafts of sample 'GHG Project Plans' and 'Monitoring Plans' might be valuable as inclusions in the Appendix.	The ACR GHG Project Plan template is available on ACR website.	☑	n/a	n/a	
G.3.1	There is no guarantee that the 90% confidence interval (CI) for any particular set of measurements (e.g. SOC stocks, AGB stocks; do not even attempt BGB or N excretion by grazing livestock…) will be within 10% of the mean. Either a preliminary scoping trial will be required to verify that the sampling technique (e.g. 0.25 m^2 quadrat for AGB collection) and intensity (number of samples per stratum; with variability strongly depended on stratification according to landscape/terrain/soil, plant community, etc.) or a very intensive sampling plan that errs on the side of high precision will be required. Both these options are expensive and would culminate in high 'transaction costs' for ACoGS. Instead, since land use in participant fields should remain static, would it be acceptable to provide maybe three attempts (or years?)	Further guidance added for when values exceed 10% of the 90% CI, i.e. deduction shall be based on lower bound of 90% CI. This approach is used in the ACR Standard and ACR Forest Carbon Project Standard.	If the location of the monitoring plot is disclosed, what are the risks that the plot could be manipulated such that the GHG reductions at the monitoring plot greatly exceed those attained on a majority of the participant field?	Such manipulation or gaming is not likely as the project conditions are assumed at steady state, i.e. no change in SOC or biomass. As baseline conditions and emissions are hypothetical, there are no opportunities to manipulate the monitoring plot. Ideally, the measurement and monitoring protocol would sufficiently control against these types of activities if they were feasible.	☑	

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	to reach the CI specification? This might allow for adaptive adjustment of sampling stratification, technique and intensity.					
G.3.2	The archiving period of 2 years seems short, relative to standard accounting practices. Also, data should include landscape and air photographs to document LU/LC. If soil samples are collected, the sampling plan/map and small, representative sub-samples might be carefully stored (air-dry, cool, dark) in the event future analyses are required.	Additional requirements added for soil archiving. Documentation of LU/LC would be included under "project related documents", but additional language has been added to make this explicit.	☑ The investment in soil sampling certainly warrants proper archiving for a sufficiently long time. Perhaps specify that "these shall be stored in an air-dry condition until…"	n/a	n/a	
G.3.3	Clarify the definition of a 'verification event'. Since LU/LC in the participant fields are largely static (apart from fluctuations in livestock numbers), the main factor affecting the GHG offsets will be hypothetical conditions in the hypothetical cropland/baseline which had been avoided (section G.3.3.2). Would it be reasonable to select a uniform 'evaluation interval' of 5 or 10 years for both project rangeland and hypothetical cropland?	A verification event is when a verification occurs and ERTs are issued. Correct, the main factors affecting ERT volumes will be management in the baseline. The open ended evaluation interval, within 5 years, is from the ACR Standard, 8.B.	There are no parameters listed in section G.3; perhaps this should be changed to section F and Appendix A. So changing market conditions, farm policies, agricultural technologies, etc. all might factor into shifting the baseline scenario at 5 year intervals (or more frequent), correct?	Thanks for catching; "section G.3" has been changed to "Section F and Appendix A".	☑	
G.3.3.2	Need to be more inclusive of all potential management variables (e.g., irrigation, manure application, etc.).	Section edited to reference all variables identified in section B.1.1.1.	☑	n/a	n/a	
G.3.3.4	Estimating the uncertainty for all input data (section G.3.3.4) may be unrealistic. For example, biogeochemical models often require information on soil texture, but rather than incurring the expense of sampling and analyzing soils for sand, silt and clay, a typical texture for the dominant soil series in a particular stratum may suffice. Clarify which sources of uncertainty are to be confronted. Is a stochastic model with a weather variability/extreme generator required to forecast changes in C and N stocks and GHG emissions? Likely the primary concern is on the variability of the C and N stock	Requirements have been edited to address commenter's concern. We appreciate pointing out the ambiguity of requirements for input data, where it is the uncertainty of the output/estimates that are of concern.	The most influential uncertainties will be the C and N stocks and typical GHG fluxes. Estimates of non-CO_2 GHG likely will largely depend on emission factors derived from consensus exercises, meta analyses, or possibly from process models.	Thank you for the suggested guidance. The following sentence was added to the end of the first paragraph: "It is anticipated that primary uncertainties to be estimated will include those for carbon pools and typical nitrogen fluxes, as most non-CO2 GHG uncertainty estimates will be based upon externally derived emission factors.	☑	

	1st review	Response	2nd review	Response	Final Review	Final Response
	sizes used to initialize the model.					

H. References and Other Information

	1st review	Response	2nd review	Response	Final Review	Final Response
H.	Consider reviewing and including the publications mentioned in the review comments. Scant information on the scientific basis for this ACoGS protocol is provided in the reference section. It should include a wider range of at least key review papers on terrestrial C storage and GHG emissions in rangelands and shrublands, with specific consideration of the influence of land use change.	Additional publications, those suggested in the review comments and also others by the authors, have been added.	☑	n/a	n/a	n/a
H.	The papers tabulated on p. 58 should be discussed in the text of section F.3.2, but the references to the papers should be in section H.	If the reviewers feel strongly that it is necessary to alter the papers tabulated on p.58, then we can do so. However, we feel the format provides a clear format to outline the assumptions and literature used to justify the 20% default rate. References to papers are included in section H.	☑ The revisions to the Table on pages 69-70 are entirely acceptable as proposed. We do not require alteration of the papers tabulated there.	n/a	n/a	n/a
H.	The references to all 'tools' and IPCC documents, including those cited in the Appendix should also appear in section H.	References have been added.	☑	n/a	n/a	n/a

Appendix A

	1st review	Response	2nd review	Response	Final Review	Final Response
App. A	P.73, bottom row: Define PE.	PE is defined is Project Emissions.	Good to know – we usually regard it as potential evapotranspiration.	Can this comment be closed?	☑	

	1st review	Response	2nd review	Response	Final Review	Final Response
App. A	P. 82, 'Frequency of monitoring/recording' row: Rephrase end of sentence to '…and every 5 years thereafter.'	Edited as suggested.	☑	n/a	n/a	n/a